A Practical Guide to Generating Event Data

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Outline

- Existing data sets
- Unix and programming
- Downloading and formatting
- Named entity recognition
- Coding with TABARI
- Actor and event ontologies
- Aggregation
- High-volume coding

Existing data sets

Dataset	Focus	Geographical	Years	Geo-located?	Reference
VAR	general	global	1990-2004	no	[King and Lowe, 2006]
KEDS	general	primarily Middle East	1979-present	no	[Schrodt and Gerner, 2010]
ICEWS	general	Asia; global	1998-2010	no	[O'Brien, 2010]
SPEED	general	global	1946-present	no	[Nardulli, 2011]
ACLED	conflict	primarily Africa	1997-2010	yes	[Raleigh et al., 2010]
MID3 Incidents	conflict	global	1993-2001	no	[COW, 2007]
ACD	conflict	global	1998-2010	no	[Harbom and Wallensteen, 2010]
UCDP-GED	conflict	global	1989-2009	yes	[Melander and Sundberg, 2011]
EDACS	violence	failed states	1990-2009	yes	[AuthorOne, 2012]
SCAD	protest	Africa	1990-2010	yes	[AuthorFive, 2012]
WITS	terrorism	global	2004-2010	city	[NCTC, 2011]
PITFWAD	one-sided violence	global	1995-present	yes	[PITF, 2011]
KOSVED	one-sided violence	selected states	varies by case	yes	[AuthorSeven, 2012]
NIRI	violence	Northern Ireland	1968-1998	yes	[AuthorSix, 2012]
WARICC	water-related conflict	Africa Middle East	1997-2009	yes	[AuthorFour, 2012]
Urban Violence	urban disorder	Africa , Asia	1960-2009	yes	[AuthorThree, 2012]
SIGACTS	violence	Afghanistan Iraq	2004-2010	yes	[HSRP, 2010, AuthorEight, 2012]

Event Model: Core Innovation

- Once calibrated, real-time event forecasting models can be run ***entirely*** without human intervention
  - Web-based news feeds provide a rich multi-source flow of political information in real time
  - Statistical models can be run and tested automatically, and are 100% transparent
- In other words, for the first time in human history—quite literally—we have a system that can provide real-time measures of political activity without any human intermediaries

Event Data in the [original] DARPA period

- Nation-state orientation; most analysis dealt with Cold War major power relations
- Global coverage
- Human coding
- Source texts were major Western newspapers
- Statistical models were relatively simple

Contemporary Event Data

- Substate and nonstate actors; most analysis deals with protracted conflicts
- Single-conflict and regional coverage
- Automated coding
- Source texts are from wire services (Reuters, AFP)
- Statistical models are very complex

ICEWS Event Data

- 30-gigabytes of text from Lexis-Nexis
- 25 sources
- 8-million stories
- 26-million sentences
  - Only first four sentences coded in each story
- 3-million events
- Generally two orders of magnitude greater than any prior event coding effort

What we know about event data in 2008 that *confirms* what we suspected in 1975

- Media fatigue is a major factor in event reporting
- WEIS contains most of the major categories required to code political interactions
- Human coding has about 25% error rate in long-term projects even when coders are initially trained to 90%+ accuracy
- It is impossible for human coders to keep up with coding in real time
- Comments and meetings are about 30% to 50% of most event data
- Violent events are reported disproportionately

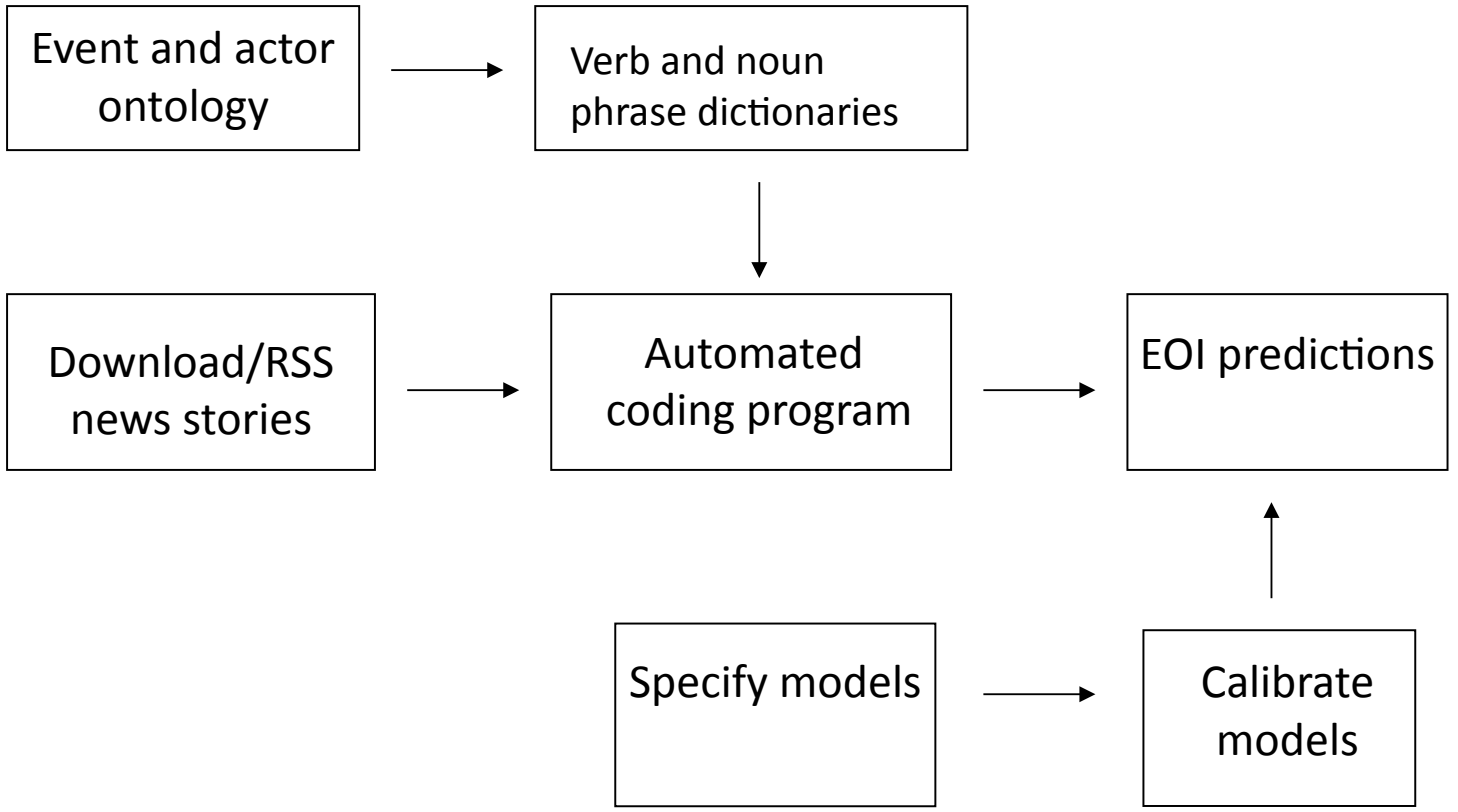
What we know about event data in 2008 that we *didn't know* in 1975

- Machine coding to a level of accuracy comparable to (or better than) multi-institution human coding teams is straightforward
- Vast quantities of news reports are available in machine-readable form and can be downloaded automatically and for free using RSS feeds
- Some WEIS categories cannot be consistently differentiated
- Scales and detailed coding categories add relatively little information; event reports alone explain about 50% to 75% of the variance
  - (but journal editors keep telling authors to remove this statistical finding from articles accepted for publication)

What we know about event data in 2008 that we *didn't know* in 1975, continued

- News sources vary dramatically in their coverage; these effects differ by region. However, news service reports provide substantially greater coverage than individual newspapers
  - Following the model of the study of pre-modern systems, we can apply what we've learned from conflicts where we have good data to conflicts where the data is not as good.
- Regionally specific data sets provide better coverage than global data data sets. It is difficult to maintain consistent coverage across the entire international system
- This assessment may change with the new ICEWS and SPEED global data sets

Event Data Generation Process



Pre-requisites

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- Stan Lee, Spiderman I

Why do we have to learn all this technical crap?!?!

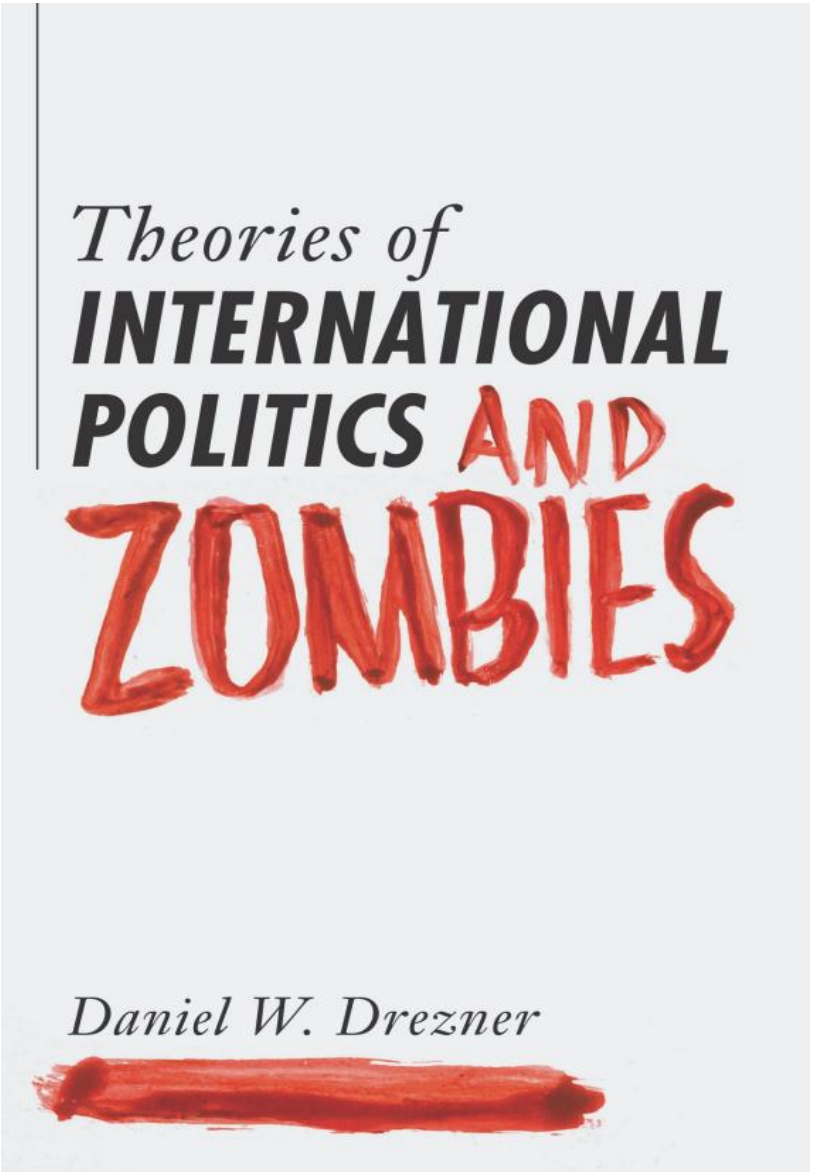
Subtext: I just want to study politics!!!

- Hey, dude, we're "scientists"…
- Could be worse…you could be a medical student…
  - Or a medieval historian
- The past fifty years have, in fact, marked a transition from where political sciences "research tools" consisted of a comfortable chair and a snifter of brandy to where we can make effective use of highly complex machines
  - Burt Monroe's legislative debate data sets at Penn State are second in size to the Sloan Sky Survey of the entire universe
- None of this is likely to change any time soon

This?…


Science
11 February 2011 | $10
data
research
information
climate
science
researchers
access
new
analysis
visualization
many
sharing
scientists
knowledge
example
human
challenges
AAAS

Or this…


Theories of
INTERNATIONAL
POLITICS AND
ZOMBIES
Daniel W. Drezner

Statistics Packages :: Cars

Statistics Packages :: Cars

Stata

Statistics Packages :: Cars

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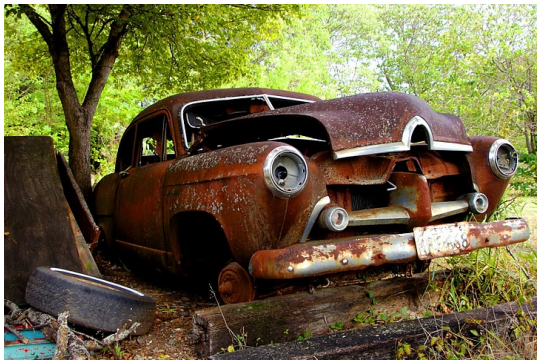

NPL Components :: Smart Phones

NLP… it’s all components

Evolution of Statistical Training in Political Science

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  - Hint: deadends— SEM, co-integration models

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- 1985: Objective is to get grad students to take advanced courses in econometrics
  - Hint: deadends— SEM, co-integration models
- 2010: Objective is to develop advanced techniques that will be adopted in other disciplines
  - Imai, Sekhon, Fowler, Gill, King
  - Hint: Medical schools are rumored to pay better than the liberal arts

The Transition We Need in Programming

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- Old model:
  - "We'll just hire a programmer because that will be more efficient than doing it ourselves"
- Reality
  - Computer science departments and ExxonMobil can't find enough programmers either
  - You take a serious efficiency hit in trying to explain what you want done
  - You may take a serious efficiency hit in not doing the task in the best way—NLP (and statistics) are specialized subfields
  - Programmers frequently are trained to focus on GUIs, (e.g. Java) which usually just get in the way in research computing

Why people don't want to be programmers

- Programming is a craft, not a science
  - “Between the mathematics that make [the computer] theoretically possible and the electronics that makes it practically feasible lies the programming that makes it intellectually, economically and socially useful. Unlike the extremes, the middle remains a craft, technical rather than technological, mathematical only in appearance."
    Michael Sean Mahoney, Histories of Computing (Harvard University Press)
  - Practice, practice, practice
- Programmer efficiency varies by a factor of 10 to 20, which can be very demoralizing
- Popular perception of programmers

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We need…

- Some formal training in core algorithms and data structures
  - Not just AP Java
- Rapid development scripting languages: perl and Python
- Lingua franca (and GUI): Java
- High performance: C/C++
- Regular expressions are to text analysis what calculus was to modeling physical systems

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Why Python

- Open source (of course...tools want to be free...)
- Standardized across platforms and widely available/documented
- Automatic memory management (unlike C/C++)
- Generally more coherent than perl, particularly when dealing with large programs
- Text oriented rather than GUI oriented (unlike Java)
- Extensive libraries but these are optional (unlike Java)
- C/C++ can be easily integrated by high-performance applications
- Tcl can be used for GUI

Why use Unix?

- Stable and compact
  - About 20 commands will do almost everything you need; they haven't changed in 30 years
- Core of all major operating systems except Windows
  - Linux, OS-X, Android
  - Most functions are identical across OS-X and Linux
- Standardized set of compilers, so identical code can run on multiple systems
- Used in most cluster computers
- Research software is more likely to be written for Unix
- Command line is more efficient than mouse/menus in advanced applications

TABARI Basics: #1 Problem people have running TABARI

Are your files in Unix format, not Windows or the old Macintosh format?

- If you saved them in Excel, they are not
- If you processed them on a Windows system, they are not

There are a variety of ways to solve this—I use BBEdit—but you have to address it

- Or send me the code to address it

TABARI Basics: #2 Problem people have running TABARI

See problem #1

Basic challenges that make text analysis hard

Definition of an “event”: KEDS Project 1992

An event is an interaction which can be described in a natural language sentence which has as its subject and direct or indirect object an element of a set of actors, and as the verb an element of a set of actions, all of which are transitive verbs, and which can be associated with a specific point in time.

Example: Some text

For everywhere we look, there is work to be done. The state of the economy calls for action, bold and swift, and we will act - not only to create new jobs, but to lay a new foundation for growth. We will build the roads and bridges, the electric grids and digital lines that feed our commerce and bind us together. We will restore science to its rightful place, and wield technology's wonders to raise health care's quality and lower its cost. We will harness the sun and the winds and the soil to fuel our cars and run our factories. And we will transform our schools and colleges and universities to meet the demands of a new age. All this we can do. And all this we will do.

What it actually looks like

• For everywhere we look, there is work to be done. The state of our economy calls for action, bold and swift. And we will act, not only to create new jobs, but to lay a new foundation for growth. We will build the roads and bridges, the electric grids and digital lines that feed our commerce and bind us together. We'll restore science to its rightful place, and wield technology's wonders to raise health care's quality and lower its cost. We will harness the sun and the winds and the soil to fuel our cars and run our factories. And we will transform our schools and colleges and universities to meet the demands of a new age. All this we can do. All this we will do.

Pre-processing

- We see distinct words, sentences, punctuation and make distinctions between entities and actions.

- A computer sees none of this… and more

- It must be instructed to distinguish what we think is important – “tokenizing”

Features

- Next step is to get machine to pay attention to the tokens that are relevant to our goals – and to ignore those that are not.
- Explicitly delineate relevant tokens – keywords
- Remove generally irrelevant stuff
  - Stop words
  - Stemming

    Note: In event data coding, this is usually done implicitly in the dictionaries rather than as an explicit processing step

Stop words and Stemming

Stop words

•a about above across after again against all almost alone along…. t take taken than that the their them then ….

Stemming

•Suffix stripping
- "ing"

•N-grams
- "post office"

•Lemmatization
- "meeting"

•It's complicated!

Sources

International news sources

- Reuters
- Agence France Presse (AFP)
- BBC (various news feeds)
- AP and UPI
- Xinhau (excellent Africa coverage)
- New York Times
- Washington Post
- Deutsche Presse-Agentur

International news sources

- This is very much a moving target due to the changing dynamics of news gathering
- Coverage differs dramatically by region: “follow the money”
- Generally only available 1990 (or so) to the present; NYT Historical is an exception
- Most of these have web pages where you can get current content, but past content is limited

Lexis-Nexis and Factiva

- No one has figured out how to automate the downloads of these
  - Instead, get your search string as precise as possible to reduce unnecessary downloads, then slog away...
- The LN search engine is very unpredictable: it is not designed for this sort of thing. Money (as in “DARPA”) was insufficient to solve the problem
  - Note that this contradicts the advice immediately above
- Factiva is far more reliable but somewhat more awkward to use
  - Money could solve that problem, but more money than you probably have.

European Media Monitor

- Project of the EU's Joint Research Center
- Monitors over 4000 sites from 1600 key news portals world-wide plus 20 commercial news feeds and, for some applications, also specialist sites.
- Retrieves over 40000 reports per day in 43 languages.
- Classifies all news according to hundreds of subjects and countries.
- Access on the web, via email and by RSS.
- Runs 24 hours per day, 7 days a week.

Source: http://emm.jrc.it/overview.html

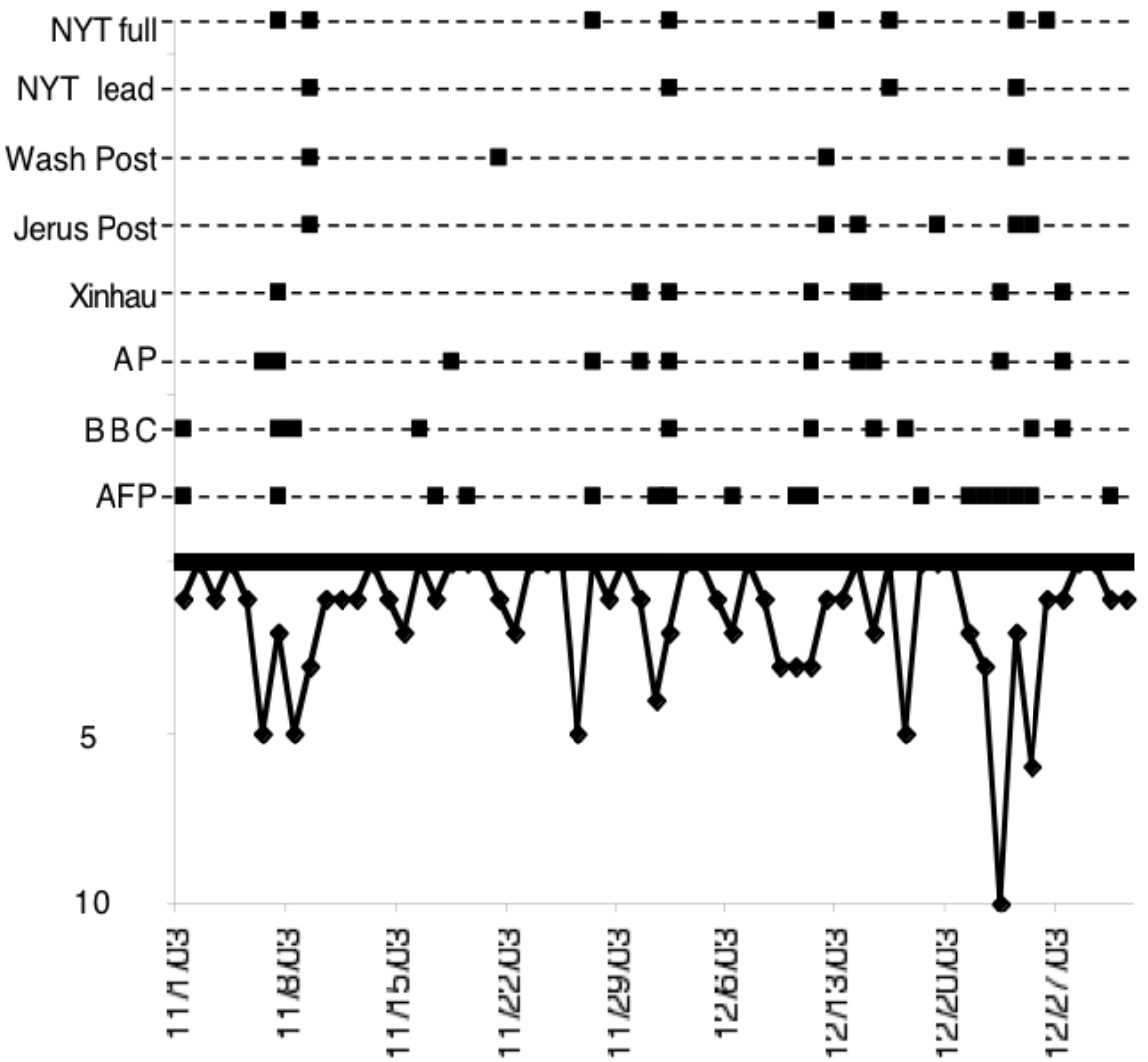
Google News

- 4500 English-language sources
- Appears to have facility for duplicate detection
- It's Google…

Number of stories found with “Palestinian killed” NEXIS search string

Newspaper		**Wire Service**	
•*Los Angeles Times*	3	•Xinhau	8
•*New York Times*	4	•BBC (Factiva)	10
•*Washington Post*	4	•Associated Press	11
•*Jerusalem Post*	6	•Agence France Presse	18
•*New York Times*, full text	8		

Comparison of newspaper and wire service coverage of Palestinian deaths, Nov-Dec 2003



Duplicate detection

- Sources:
- Use of newswires (exact duplicates are easy)
- Updating and corrections of previous stories
- News summaries
- Chronologies
- Multiple independent sources (Reuters, AFP, BBC)
- This is a difficult problem
- One-a-Day filter
- Duplication probably amplifies the signal you want

How many sources are needed?

- Probably 80% can be obtained from the major international sources
- Local sources do not necessarily give you better coverage of important political events
- Censorship (official or voluntary) is an issue
- International coverage follows the money
- There is probably a lot of regional variation on this
- Same for non-English sources: possibility of using machine translation

Source and consistency of text

How much work will be involved in getting the text into a form you can use?

- ASCII/UniCode text, for example news reports
- HTML
  - web formats change frequently
- PDF
- Scanned/OCR text
- Proprietary word processing formats (Word)
- New media sources such as blogs and tweets

Style of language

- News reports and official documents are usually formal, syntactically-correct English
- Quotations and letters are a mix of formal and informal
- Open-ended responses range from formal to very fragmentary
- New media sources are often very informal and abbreviated
- Variants of English and changes in usage over time (e.g. slang, memes)
- Languages other than English

Intellectual property

•Copyright law is generally open to “fair use” in research and education. However, institutional contracts with data providers are more limited

- Information does not necessarily want to be free

•Human subjects considerations—and therefore IRB review—apply to identifiable data

•A lot of the legal issues, particularly involving content on the web, are still *very* open

- You probably do not want to be a test case
- Just because someone claims IP rights doesn't mean they actually have those right
- You probably do not want to be a test case
- Public institutions have considerable protection from sovereign immunity, though many have been wimps in asserting this.
- This may be substantial clarified (or not) by a current case before the Supreme Court

And of course, costs

- Is the information source already formatted?
  - Spinn3R, Thomas ☺
  - Web pages vary dramatically in ease of downloading
- How much data do you actually need?
  - Text data sets are frequency much, much larger than typical political science data such as surveys and national indicators
  - Will just a sample be sufficient?
  - Are you coding more information than you will actually use?
- How much time will it take to code each document?
  - Who's going to train and supervise the manual coders?
  - How much can be fully automated?
  - How good is good enough?

TABARI

Textual Analysis By Augmented Replacement Instructions (TABARI)

- ANSI C++, approximately 14,000 lines of code
- Open-source (GPL)
- Unix, Linux and OS-X operating systems (gcc compiler)
- “Teletype” interface: text and keyboard
  - Easily deployed on a server
- Codes around 5,000 events per second on contemporary hardware
  - Speed is achieved through use of shallow parsing algorithms
  - Speed can be scaled indefinitely using parallel processing
- Standard dictionaries are open source, with around 15,000 verb phrases for events and 30,000+ noun phrases for actors

Additional automated coding systems

- VRACoder (Bond, VRA, Cambridge, MA)
  - IDEA coding system
  - Deep parsing
  - Proprietary, Windows environment
- PERICLES (Shellman, Strategy Analysis Enterprises)
  - CAMEO coding system, dictionaries
  - Multi-field capabilities
  - Open-source, C#/.NET environment
- JABARI-NLP (Lockheed Martin)
  - TABARI structure with open-source parsing
  - Some geolocation capabilities; extensive substate actor coding

Reuters Chronology of 1990 Iraq-Kuwait Crisis - 1

July 17, 1990: RESURGENT IRAQ SENDS SHOCK WAVES THROUGH GULF ARAB STATES

Iraq President Saddam Hussein launched an attack on Kuwait and the United Arab Emirates (UAE) Tuesday, charging they had conspired with the United States to depress world oil prices through overproduction.

July 23, 1990: IRAQ STEPS UP GULF CRISIS WITH ATTACK ON KUWAITI MINISTER

Iraqi newspapers denounced Kuwait's foreign minister as a U.S. agent Monday, pouring oil on the flames of a Persian Gulf crisis Arab leaders are struggling to stifle with a flurry of diplomacy.

July 24, 1990: IRAQ WANTS GULF ARAB AID DONORS TO WRITE OFF WAR CREDITS

Debt-burdened Iraq's conflict with Kuwait is partly aimed at persuading Gulf Arab creditors to write off billions of dollars lent during the war with Iran, Gulf-based bankers and diplomats said.

Reuters Chronology of 1990 Iraq-Kuwait Crisis - 2

July 24, 1990: IRAQ, TROOPS MASSED IN GULF, DEMANDS $25 OPEC OIL PRICE

Iraq's oil minister hit the OPEC cartel Tuesday with a demand that it must choke supplies until petroleum prices soar to $25 a barrel.

July 25, 1990: IRAQ TELLS EGYPT IT WILL NOT ATTACK KUWAIT

Iraq has given Egypt assurances that it would not attack Kuwait in their current dispute over oil and territory, Arab diplomats said Wednesday.

July 27, 1990: IRAQ WARNS IT WON'T BACK DOWN IN TALKS WITH KUWAIT

Iraq made clear Friday it would take an uncompromising stand at conciliation talks with Kuwait, saying its Persian Gulf neighbor must respond to Baghdad's "legitimate rights" and repair the economic damage it caused.

July 31, 1990: IRAQ INCREASES TROOP LEVELS ON KUWAIT BORDER

Iraq has concentrated nearly 100,000 troops close to the Kuwaiti border, more than triple the number reported a week ago, the Washington Post said in its Tuesday editions.

Reuters Chronology of 1990 Iraq-Kuwait Crisis - 3

August 1, 1990: CRISIS TALKS IN JEDDAH BETWEEN IRAQ AND KUWAIT COLLAPSE

Talks on defusing an explosive crisis in the Gulf collapsed Wednesday when Kuwait refused to give in to Iraqi demands for money and territory, a Kuwaiti official said.

August 2, 1990: IRAQ INVADES KUWAIT, OIL PRICES SOAR AS WAR HITS PERSIAN GULF

Iraq invaded Kuwait, ousted its leaders and set up a pro-Baghdad government Thursday in a lightning pre-dawn strike that sent oil prices soaring and world leaders scrambling to douse the flames of war in the strategic Persian Gulf.

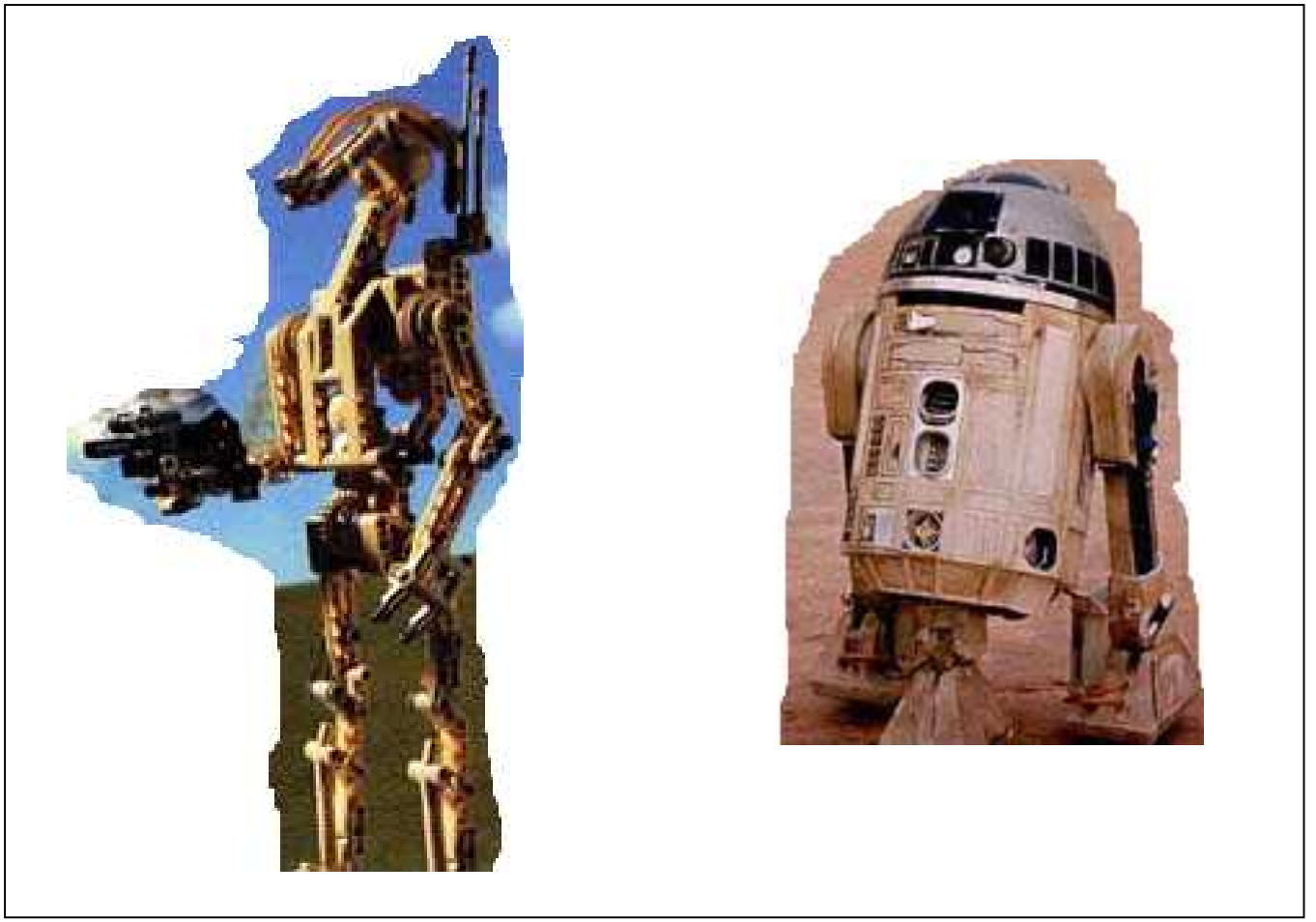
Source: Reuters

MIT Robotics 101: First exercise

“Design a robot to wash dishes”

Robotics 101: First Exercise
Most frequent answer

Robotics 101: First Exercise
Slightly more appropriate answers



Robotics 101: First Exercise
Correct answer

Human and Automated Coding

Implications for automated coding

- Old objective:

Machine coding should attempt to duplicate human coders

  - (which, in fact, can be done: Schrodt and Gerner 1994, Bond et al 1997, Thomas 2001, King and Lowe 2003)
  - Also human coding accuracy is probably *much* worse that the 80% that is usually claimed

- Alternative objective:

Optimize coding systems and models to use information that can be coded most reliably by machine

Reliability in content analysis

- **Stability**—the ability of a coder to consistently assign the same code to a given text;
- **Reproducibility**—intercoder reliability;
- **Accuracy**—the ability of a group of coders to conform to a standard.

Source: Weber (1990:17)

Advantages of automated coding

- Fast and inexpensive
- Transparent: coding rules are explicit in the dictionaries
- Reproducible: a coding system can be consistently maintained over a period of time without the "coding drift" caused by changing teams of coders.
- Coding dictionaries are also be shared between institutions
- The coding of individual reports is not affected by the biases of individual coders. Dictionaries, however, can be so affected.
- Can create rules for difficult tecchnical and cultural vocabulary that is otherwise difficult to learn

Disadvantages of automated coding

- Automated thematic coding has problems with disambiguation; automated syntactic coding makes errors on complex sentences.
- Requires a properly formatted, machine-readable source of text, therefore older paper and microfilm sources are difficult to code.
- Development of new coding dictionaries is time-consuming—KEDS/PANDA initial dictionary development required 2-labor-years. (Modification of existing dictionaries, however, requires far less effort)

Human and machine coding tradeoffs

- Machine coding uses only information that is explicit in the text; human coders are likely to use implicit knowledge of the situation.
- Machine coding is not affected by boredom and fatigue
- Human coders can more effectively interpret idiomatic and metaphorical text, provided they are familiar with the context
- Human coders can more effectively deal with complex subordinate phrases and other unexpected grammatical constructions

Summary

Advantage to human coding

- Small data sets
- Data coded only one time at a single site
- Existing dictionaries cannot be modified
- Complex sentence structure
- Metaphorical, idiomatic, or time-dependent text
- Money available to fund coders and supervisors

Advantage to machine coding

- Large data sets
- Data coded over a period of time or across projects
- Existing dictionaries can be modified
- Simple sentence structures
- Literal, present-tense text
- Money is limited

Word frequency in English

% of usage	# of words
40%	50
60%	2,300
85%	8,000
99%	16,000

- Total words in American English: about 600,000
- Total words in technical English (all fields): about 3-million

Functional Words

Very short words such as

- Articles: `a an the`
- Interogatives: `who what when where why how`
- Prepositions: `to from at in above below`
- Auxillary verbs: `have has was were been`
- Markers: `by in at to` (French `de`, German `du`, Arabic `fi`)
- Pronouns: `I you he she him her his hers`

In English, the specificity of a word is *generally* proportional to its length. These short will typically be in the stop word list, though a few longer words (e.g. “though” and “although”) also will be stop words

Marker words have multiple uses: *Random House College Dictionary* lists 29 meanings for “by,” 31 for “in,” 25 for “to,” and 15 for “for.”

It gets harder: Disambiguation (“Bat”)

- Noun
  - wooden (or aluminum) cylinder used in the game of baseball
  - small flying mammal
- Verb
  - act of batting (“at bat”)
  - blinking (“bat an eye”)
- Idiomatic uses
  - “go to bat for”: defending or interceding;
  - “right off the bat”: immediately;
  - “bats in the belfry”: commentary on an individual’s cognitive ability
- Foreign phrases
  - “bat mitzvah”: a girl’s coming-of-age ceremony (Hebrew).

WordNet word senses: “bat”

Noun

S: (n) **bat**, chiropteran (nocturnal mouselike mammal with forelimbs modified to form membranous wings and anatomical adaptations for echolocation by which they navigate)

S: (n) **bat**, at-bat ((baseball) a turn trying to get a hit) *"he was at bat when it happened"; "he got four hits in four at-bats"*

S: (n) squash racket, squash racquet, **bat** (a small racket with a long handle used for playing squash)

S: (n) cricket bat, **bat** (the club used in playing cricket) *"a cricket bat has a narrow handle and a broad flat end for hitting"*

S: (n) **bat** (a club used for hitting a ball in various games)

Verb

S: (v) **bat** (strike with, or as if with a baseball bat) *"bat the ball"*

S: (v) **bat**, flutter (wink briefly) *"bat one's eyelids"*

S: (v) **bat** (have a turn at bat) *"Jones bats first, followed by Martinez"*

S: (v) **bat** (use a bat) *"Who's batting?"*

S: (v) cream, **bat**, clobber, drub, thrash, lick (beat thoroughly and conclusively in a competition or fight) *"We licked the other team on Sunday!"*

Disambiguation, cont.

•Any of these uses might be encountered in an English-language text. Multiple uses might be found in a single sentence:

> "The umpire didn't bat an eye as Sarah lowered her bat to watch the bat flying around the pitcher."

Disambiguation, cont.

•Words can also change from verbs to nouns without modification. Consider

- `I plan to drive to the store, then wash the car.`
- `When John returned from the car wash, he parked his car in the drive.`

•In summary:

"Verbing weirds language."

Bill Watterson, *Calvin and Hobbes*

WordNet word senses: “attack”

Noun

S: (n) **attack**, onslaught, onset, onrush ((military) an offensive against an enemy (using weapons)) *"the attack began at dawn"*

S: (n) **attack** (an offensive move in a sport or game) *"they won the game with a 10-hit attack in the 9th inning"*

S: (n) fire, **attack**, flak, flack, blast (intense adverse criticism) *"Clinton directed his fire at the Republican Party"; "the government has come under attack"; "don't give me any flak"*

S: (n) approach, **attack**, plan of attack (ideas or actions intended to deal with a problem or situation) *"his approach to every problem is to draw up a list of pros and cons"; "an attack on inflation"; "his plan of attack was misguided"*

S: (n) **attack**, attempt (the act of attacking) *"attacks on women increased last year"; "they made an attempt on his life"*

S: (n) **attack**, tone-beginning (a decisive manner of beginning a musical tone or phrase)

S: (n) **attack** (a sudden occurrence of an uncontrollable condition) *"an attack of diarrhea"*

S: (n) **attack** (the onset of a corrosive or destructive process (as by a chemical agent)) *"the film was sensitive to attack by acids"; "open to attack by the elements"*

S: (n) **attack** (strong criticism) *"he published an unexpected attack on my work"*

Verb

S: (v) **attack**, assail (launch an attack or assault on; begin hostilities or start warfare with) *"Hitler attacked Poland on September 1, 1939 and started World War II"; "Serbian forces assailed Bosnian towns all week"*

S: (v) **attack**, round, assail, lash out, snipe, assault (attack in speech or writing) *"The editors of the left-leaning paper attacked the new House Speaker"*

S: (v) **attack**, aggress (take the initiative and go on the offensive) *"The Serbs attacked the village at night"; "The visiting team started to attack"*

S: (v) assail, assault, set on, **attack** (attack someone physically or emotionally) *"The mugger assaulted the woman"; "Nightmares assailed him regularly"*

S: (v) **attack** (set to work upon; turn one's energies vigorously to a task) *"I attacked the problem as soon as I got out of bed"*

S: (v) **attack** (begin to injure) *"The cancer cells are attacking his liver"; "Rust is attacking the metal"*

WordNet word senses: “head”

Noun

S: (n) **head**, caput (the upper part of the human body or the front part of the body in animals; contains the face and brains) *"he stuck his head out the window"*

S: (n) **head** (a single domestic animal) *"200 head of cattle"*

S: (n) mind, **head**, brain, psyche, nous (that which is responsible for one's thoughts and feelings; the seat of the faculty of reason) *"his mind wandered"; "I couldn't get his words out of my head"*

S: (n) **head**, chief, top dog (a person who is in charge) *"the head of the whole operation"*

S: (n) **head** (the front of a military formation or procession) *"the head of the column advanced boldly"; "they were at the head of the attack"*

S: (n) **head** (the pressure exerted by a fluid) *"a head of steam"*

S: (n) **head** (the top of something) *"the head of the stairs"; "the head of the page"; "the head of the list"*

S: (n) fountainhead, headspring, **head** (the source of water from which a stream arises) *"they tracked him back toward the head of the stream"*

S: (n) **head**, head word ((grammar) the word in a grammatical constituent that plays the same grammatical role as the whole constituent)

S: (n) **head** (the tip of an abscess (where the pus accumulates))

S: (n) **head** (the length or height based on the size of a human or animal head) *"he is two heads taller than his little sister"; "his horse won by a head"*

S: (n) capitulum, **head** (a dense cluster of flowers or foliage) *"a head of cauliflower"; "a head of lettuce"*

S: (n) principal, school principal, head teacher, **head** (the educator who has executive authority for a school) *"she sent unruly pupils to see the principal"*

S: (n) **head** (an individual person) *"tickets are $5 per head"*

S: (n) **head** (a user of (usually soft) drugs) *"the office was full of secret heads"*

S: (n) promontory, headland, **head**, foreland (a natural elevation (especially a rocky one that juts out into the sea))

S: (n) **head** (a rounded compact mass) *"the head of a comet"*

S: (n) **head** (the foam or froth that accumulates at the top when you pour an effervescent liquid into a container) *"the beer had a large head of foam"*

S: (n) forefront, **head** (the part in the front or nearest the viewer) *"he was in the forefront"; "he was at the head of the column"*

S: (n) pass, **head**, straits (a difficult juncture) *"a pretty pass"; "matters came to a head yesterday"*

S: (n) headway, **head** (forward movement) *"the ship made little headway against the gale"*

S: (n) point, **head** (a V-shaped mark at one end of an arrow pointer) *"the point of the arrow was due north"*

S: (n) question, **head** (the subject matter at issue) *"the question of disease merits serious discussion"; "under the head of minor Roman poets"*

WordNet word senses: “head” continued

Noun

S: (n) heading, header, **head** (a line of text serving to indicate what the passage below it is about) *"the heading had little to do with the text"*

S: (n) **head** (the rounded end of a bone that fits into a rounded cavity in another bone to form a joint) *"the head of the humerus"*

S: (n) **head**, caput (the upper part of the human body or the front part of the body in animals; contains the face and brains) *"he stuck his head out the window"*

S: (n) **head** (that part of a skeletal muscle that is away from the bone that it moves)

S: (n) read/write head, **head** ((computer science) a tiny electromagnetic coil and metal pole used to write and read magnetic patterns on a disk)

S: (n) **head** ((usually plural) the obverse side of a coin that usually bears the representation of a person's head) *"call heads or tails!"*

S: (n) **head** (the striking part of a tool) *"the head of the hammer"*

S: (n) **head** ((nautical) a toilet on board a boat or ship)

S: (n) **head** (a projection out from one end) *"the head of the nail", "a pinhead is the head of a pin"*

S: (n) drumhead, **head** (a membrane that is stretched taut over a drum)

Verb

S: (v) **head** (to go or travel towards) *"where is she heading"; "We were headed for the mountains"*

S: (v) **head**, lead (be in charge of) *"Who is heading this project?"*

S: (v) lead, **head** (travel in front of; go in advance of others) *"The procession was headed by John"*

S: (v) **head**, head up (be the first or leading member of (a group) and excel) *"This student heads the class"*

S: (v) steer, maneuver, manoeuver, manoeuvre, direct, point, **head**, guide, channelize, channelise (direct the course; determine the direction of travelling)

S: (v) **head** (take its rise) *"These rivers head from a mountain range in the Himalayas"*

S: (v) **head** (be in the front of or on top of) *"The list was headed by the name of the president"*

S: (v) **head** (form a head or come or grow to a head) *"The wheat headed early this year"*

S: (v) **head** (remove the head of) *"head the fish"*

Memes, idioms, metaphors and slang

- Political text frequently uses distinct idiomatic phrases
  - “Right to life”, “right to choice”
- Memes can have a high frequency for brief periods of time
  - “lipstick on a pig”
  - “top kill”, “junk shot”, “Deep Horizon”
- Military metaphors are common in political (and sports) rhetoric
  - “Tea Party insurgency”, “battleground state”
- OMG! WTF! Like IMHO slang expressions are common, and rapidly changing, in new media (lol…)

Lessons from event data: dictionary calibration

- Existing verb-phrase dictionary required relatively little modification
- Actor dictionaries would benefit from re-structuring into general and country specific dictionaries
  - General: international actors, both state and non-state
  - General: discard phrases
  - Specific: national and regional actors
- There is still considerable divergence between the PCS and CAMEO actor coding schemes, though they are probably roughly equivalent at the level of aggregation used in these models

TABARI Project file

Coding file for events for ICEWS Nov09 coding, 10 November 2009
<dochead> Text source: leads only. Source: Agence France Press and Reuters
<doctail> For further information on the TABARI automated coding program and CAMEO
<doctail> coding system, consult http://web.ku.edu/keds<verbsfile>
CAMEO.091023.master.verbs
<actorsfile> nouns_adj_null.091023.txt
<actorsfile> Countries.091023.actors
<actorsfile> Internatnl.090916.rev.actors
<agentfile> ICEWS.091023sorted.agents
<issuesfile> GTDS.issues
<optionsfile> CAMEO.09b5.options
<textfile> LN.Texts0911.97.1
<textfile> LN.Texts0911.97.2
<textfile> LN.Texts0911.98.1
<textfile> LN.Texts0911.98.2
<textfile> LN.Texts0911.99.1
<textfile> LN.Texts0911.99.2
<textfile> LN.Texts0911.99.3
<eventfile> ICEWS.Nov09.pt1.evt
<coder> PAS
<session 1> <coder PAS> <date Wed 11 Nov 2009> <start 11:41 CST> <end 12:10 CST>
<records 6933308> <actorchanges 0> <verbchanges 0> <last 0>
<session 2> <coder PAS> <date Wed 11 Nov 2009> <start 12:17 CST> <end 12:43 CST>
<records 6933308> <actorchanges 0> <verbchanges 0> <last 0>

Event Coding systems

- WEIS
  - Charles McClelland, Rodney Tomlinson, DARPA
- COPDAB
  - Edward Azar
- PANDA
  - Doug Bond
- IDEA
  - Doug Bond, Craig Jenkins and Charles Taylor
- CAMEO
  - Deborah Gerner and Philip Schrodt

Categorization of Political Interactions

- Distinct English-language verb phrases:
5,000 to 10,000
(MUC, KEDS, PANDA projects)
- Micro-level categories
50 to 150
(WEIS, BCOW, IDEA, CAMEO)
- Macro-level categories
10 to 20
(WEIS, COPDAB, IPB, World Handbook)

CAMEO: Event Coding

- Combines ambiguous categories in WEIS (promise/agree, grant/reward, warn/threaten)
- Eliminates WEIS subcategories for which no examples could be found
- Substantially expands coding for acts of violence
- Coding categories can be expanded to three levels
  - Originally designed for coding mediation but subsequently generalized for coding actions of militarized non-state actors
- Complete coding manual with examples of all event categories
- Implemented with a 15,000 verb phrase dictionary

CAMEO: Actor Coding

- Systematic hierarchical scheme for coding sub-state and non-state actors
- Typical full actor code has three levels
  - State
  - Role
  - Identity
- Example: Hamas is coded PSEREBHMS
  - PSE:ISO-3166-alpha-3 code for the West Bank and Gaza
  - REB: Militarized opposition group
  - HMS: individual code for Hamas
- Additional rules standardize the coding of IGOs, NGOs, government leaders and so forth

CAMEO Actor Coding: Block 1

- ISO-3166-1-alpha 3 country codes
- Religious/ethnicity codes
  - HURIDOCS religion codes
  - Maoz/Henderson religion codes?
  - ??? ethnicity codes
- Generic International/Transnational Actor Codes

CAMEO Actor Coding: Block 2

- Generic Domestic Actor/Role codes
  Modified from PANDA/IDEA codes
- Sub-state Region codes
  Possibility of using various UN and ISO geographical sources that code economic data
- Religious/ethnicity codes
- Special International/Transnational Actor Codes
- Country codes for NGOs and MNCs

CAMEO Actor Coding: Block 3

- Generic Domestic Actor/Role codes
- Religious/ethnicity codes
- Branches of international organizations
- Special Actor Codes

Sources for dictionaries

CountryCodes

CountryCodes

- <Country>
- <CountryCode>ATG</CountryCode>
- <CountryName>ANTIGUA_AND_BARBUDA</CountryName>
- <COW-Alpha>AAB</COW-Alpha>
- <COW-Numeric>58</COW-Numeric>
- <FIPS-10>AC</FIPS-10>
- <ISO3166-alpha2>AG</ISO3166-alpha2>
- <ISO3166-aplha3>ATG</ISO3166-aplha3>
- <Nationality>ANTIGUANS</Nationality>
- <Nationality>BARBUDANS</Nationality>
- <Nationality>ANTIGUA</Nationality>
- <Nationality>BARBUDA</Nationality>
- <Capital>SAINT_JOHN'S</Capital>
- <Capital>ST._JOHN'S</Capital>
- <MajorCities>
- REDONDA
- </MajorCities>
- <Premiers>
- VERE_CORNWALL_BIRD_ [19670227 - 19710214] [19760201 - 19811101]
- GEORGE_WALTER_ [19710214 - 19760201] [B:19280101] [D:20080101]
- </Premiers>
- <Governors-GENERAL>; representing the british monarch as head of state
- SIR_WILFRED_E._JACOBS_ [19811101 - 19930610]
- JAMES_CARLISLE_ [19930610 - 20070717] [B:19370101]
- LOUISE_LAKE-TACK_ [20070717] [B:19440101]
- </Governors-GENERAL>
- <Prime ministers>
- VERE_CORNWALL_BIRD_ [19811101 - 19940309]
- LESTER_BIRD_ [19940309 - 20040324] [B:19380101]
- BALDWIN_SPENCER_ [20040324] [B:19480101]
- </Prime ministers>
- </Leaders>
- <Government>
- <Synonyms>

PoliNER/CodeCatcher

CodeCatcher

```
SENTENCES:  [ N = 743 ]

[ 1 ] { Israeli }[ISR] shelling of a central { Gaza
      }[PSE] stronghold of the Ezzedine Al-Qassam Brigades , the
      armed wing of >>> Hamas <<< , killed one fighter on Tuesday ,
      { Palestinian }[PSE] medics and witnesses said .
[ 2 ] Top >>> Hamas <<< official Mahmud Al-Zahar on Tuesday
      rejected the conditions set by { Palestinian }[PSE]
      president Mahmud Abbas for talks aimed at halting the factional struggle
      that has torn the territories apart .
[ 3 ] { Palestinian }[PSE] president Mahmud Abbas said on
      Monday that he was ready to " open a new page " with >>> Hamas
      <<< if the Islamist movement gave up its control of the { Gaza
      }[PSE] Strip .
[ 4 ] { Israeli }[ISR] forces in the northern { Gaza
      }[PSE] Strip killed seven { Palestinians
      }[PSE] overnight , including three militants from the
      >>> Hamas <<< movement that has ruled the { Gaza
      }[PSE] Strip since June , medics said on Wednesday .
[ 5 ] Former { Palestinian }[PSE] { lawmakers
      }[~LEG] and journalists shaved their heads in public on
      Wednesday in protest at the humiliating shaving of the moustache of a
      Fatah official by >>> Hamas <<< men in { Gaza
      }[PSE] .

SENTENCE:
      { Israeli }[ISR] shelling of a central { Gaza
      }[PSE] stronghold of the Ezzedine Al-Qassam Brigades , the
      armed wing of >>> Hamas <<< , killed one fighter on Tuesday ,
      { Palestinian }[PSE] medics and witnesses said .

CODES: 1:ISR  2:PSE

:: Hamas_ [ PSE ]
->
```

CodeCatcher

Code

A maximum of nine codes are extracted from the selected sentence; these are displayed after the selected sentence. The initial code defaults to the rst code prior to the target if it exists, otherwise the first code after the target. If there are no codes, the code is set to the discard code ###.

c< n > : add the code < n > from the list

c< n >+< m >: combine codes < n > and < m >. If the second code is an agent code|i.e.

starts with |the is removed.

c+< n >: append code < n >

ca: append text to the code

cr: remove the last three characters from the code

cc: clear code (set to empty string)

cn: enter a complete new code

c-: set null code [- - -]

c-< n; a; s; t;# >: set codes [NOUN],[ADJT],[STOP],[TIME],[NUMR]

c#: set simple discard code ###

c#< s; h; f; a >: set discard codes for sports, history, formatting, arts

Using Multiple News Sources

- "Splicing" events from multiple sources has proven to be a major problem. Coverage of major events appears to be similar but coverage of minor events such as meetings and comments can vary substantially

- All sources appear subject to "media fatigue"—interest in a crisis will decline over time. Competition between stories—for example US-Iraq versus Israel-Palestine—also affects coverage.

Major WEIS Categories

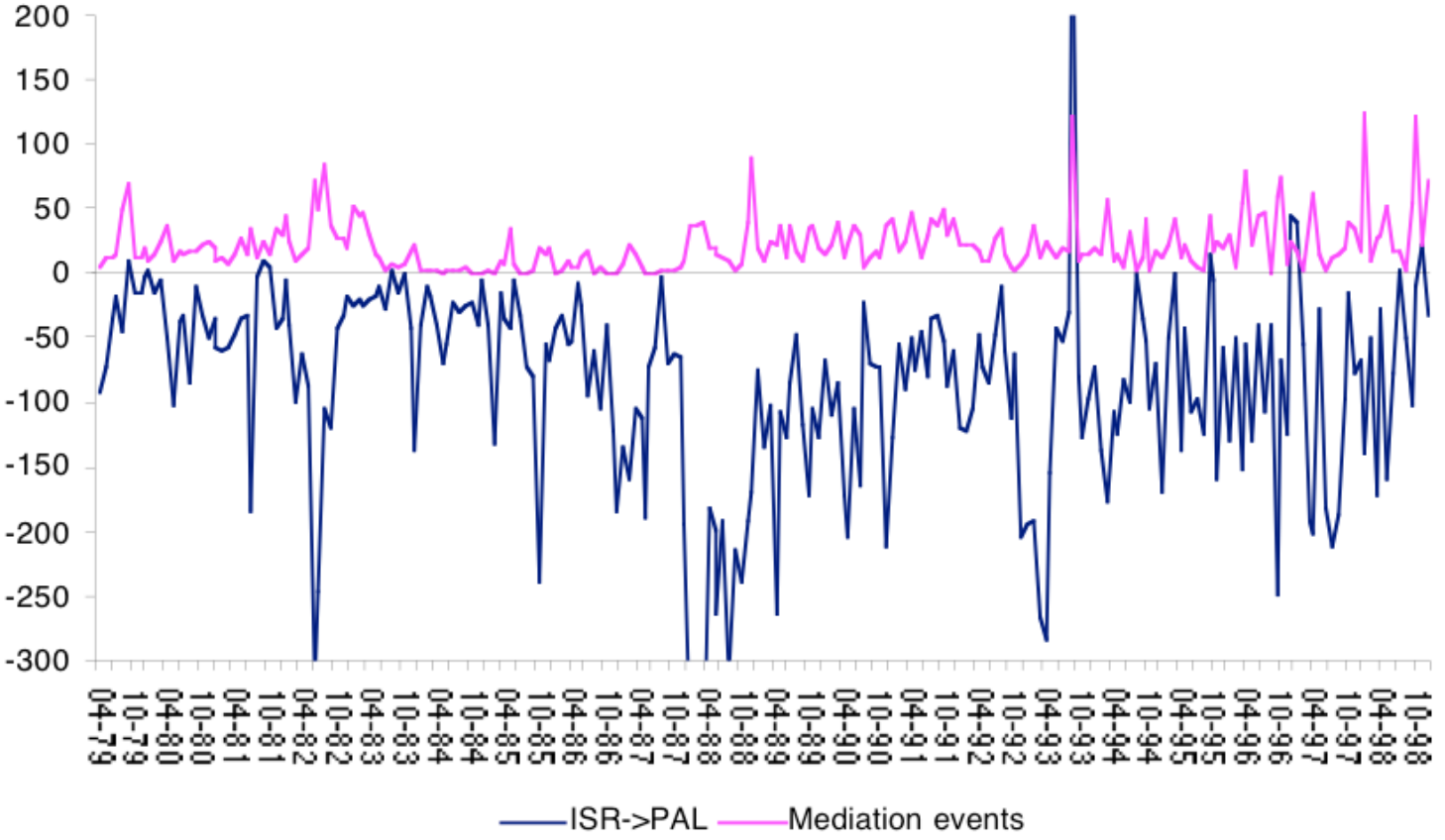
01	Yield	11	Reject
02	Comment	12	Accuse
03	Consult	13	Protest
04	Approve	14	Deny
05	Promise	15	Demand
06	Grant	16	Warn
07	Reward	17	Threaten
08	Agree	18	Demonstrate
09	Request	19	Reduce Relationship
10	Propose	20	Expel
		21	Seize
		22	Force

Goldstein Scale for WEIS Events

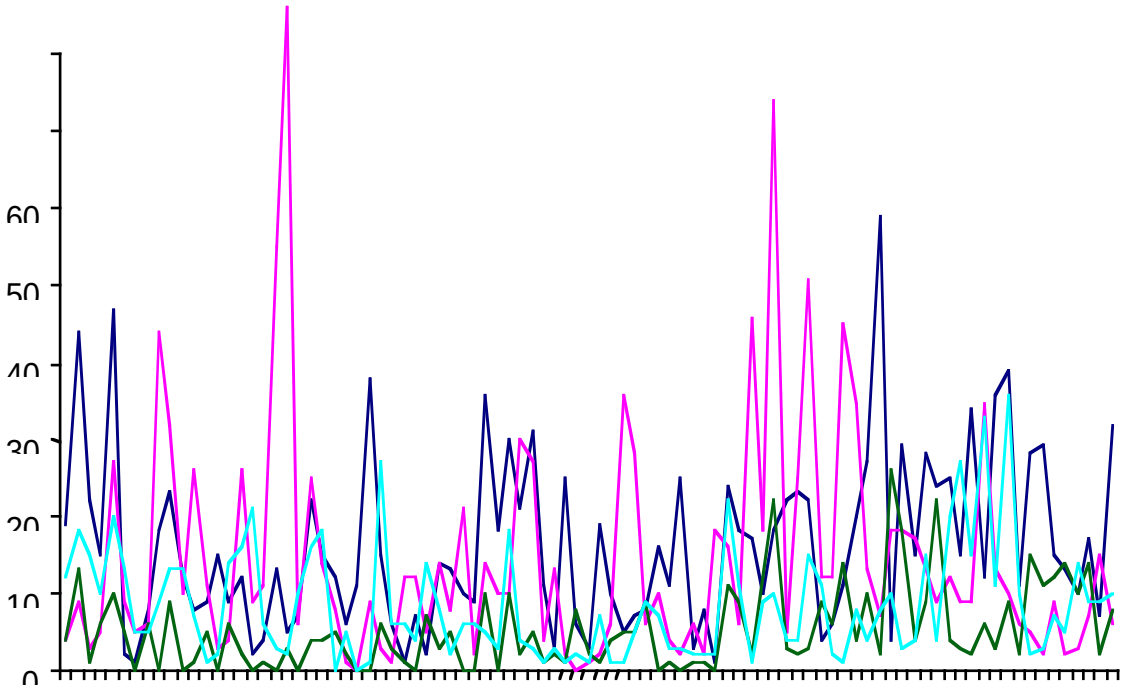
```
010: [1.0]  YIELD
011: [0.6]  SURRENDER
012: [0.6]  RETREAT
013: [2.0]  RETRACT
014: [3.0]  ACCOMODATE, CEASEFIRE
015: [5.0]  CEDE POWER

020: [0.0]  COMMENT
021: [-0.1] DECLINE COMMENT
022: [-0.4] PESSIMISTIC COMMENT
023: [-0.2] NEUTRAL COMMENT
024: [0.4]  OPTIMISTIC COMMENT

070: [7.0]  REWARD
071: [7.4]  EXTEND ECON AID
072: [8.3]  EXTEND MIL AID
073: [6.5]  GIVE OTHER ASSISTANCE
```

```
110: [-4.0] REJECT
111: [-4.0] TURN DOWN
112: [-4.0] REFUSE
113: [-5.0] DEFY LAW

170: [-6.0] THREATEN
171: [-4.4] UNSPECIFIED THREAT
172: [-5.8] NONMILITARY TRHEAT
173: [-7.0] SPECIFIC THREAT
174: [-6.9] ULTIMATUM

220: [-9.0] FORCE
221: [-8.3] NONINJURY DESTRUCTION
222: [-8.7] NONMIL DESTRUCTION
223: [-10.0] MILITARY ENGAGEMENT
```

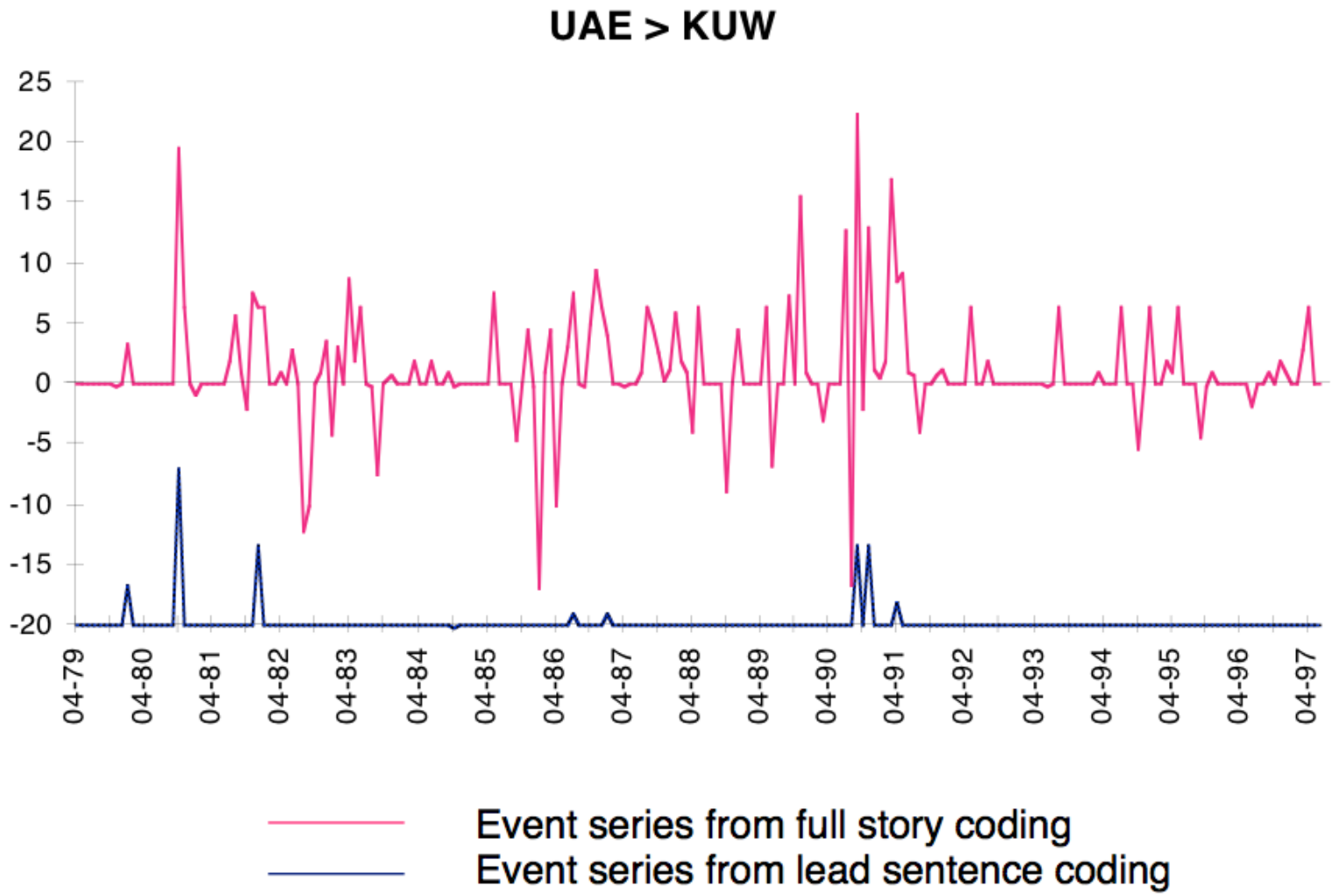
Israel-Palestine: Conflict and mediation 1979-98



The worst graphic ever produced by the KEDS project…



Goldstein series: UAE→Kuwait, 1979-97
Full-story vs. lead-sentence events



Hidden Markov models: Accuracy by positive and negative predictions

- "Correct"—percentage of the weeks that were correctly forecast, the percentage of time that a high or low conflict week would have been predicted correctly.

- "Forecast"—percentage of the weeks that were forecast as having high or low conflict actually turned out to have the predicted characteristic; the percentage of time that a type of prediction is accurate.

Balkans Hidden Markov Model: Accuracy for 23-Category Coding System

Experiment	%accuracy	% high correct	% low correct	% high forecast	% low forecast
P1	77.6	29.3	89.5	40.8	83.7
P3	76.0	29.0	87.9	37.9	82.9
P6	76.9	25.9	90.6	42.6	82.0
N1	54.2	92.7	45.3	28.1	96.4
N3	49.0	88.1	39.6	25.9	93.3
N6	47.7	88.5	37.4	26.3	92.8

Balkans Hidden Markov Model: Accuracy for 5-Category Coding System

Experiment	%accuracy	% high correct	% low correct	% high forecast	% low forecast
P1	74.4	46.2	81.5	38.9	85.6
P3	71.7	44.1	78.9	35.4	84.4
P6	71.4	44.2	78.8	36.4	83.8
N1	61.9	90.7	54.6	33.7	95.8
N3	57.8	87.0	50.2	31.4	93.6
N6	56.8	85.9	48.8	31.5	92.7

Difference in Accuracy between 23-Category and 5-Category Coding Systems

Experiment	% accuracy	% high correct	% low correct	% high forecast	% low forecast
P1	3.2	-16.9	8.0	1.9	-1.9
P3	4.3	-15.1	9.0	2.5	-1.5
P6	5.5	-18.3	11.8	6.2	-1.8
N1	-7.7	2.0	-9.3	-5.6	0.6
N3	-8.8	1.1	-10.6	-5.5	-0.3
N6	-9.1	2.6	-11.4	-5.2	0.1

Positive value: 23-category has higher accuracy

Simplifying Event Scales

Goldstein: Goldstein weights

difference: cooperative events = 1; conflictual events = -1.

total: all events = 1.

conflict: cooperative event = 0; conflictual events = 1.

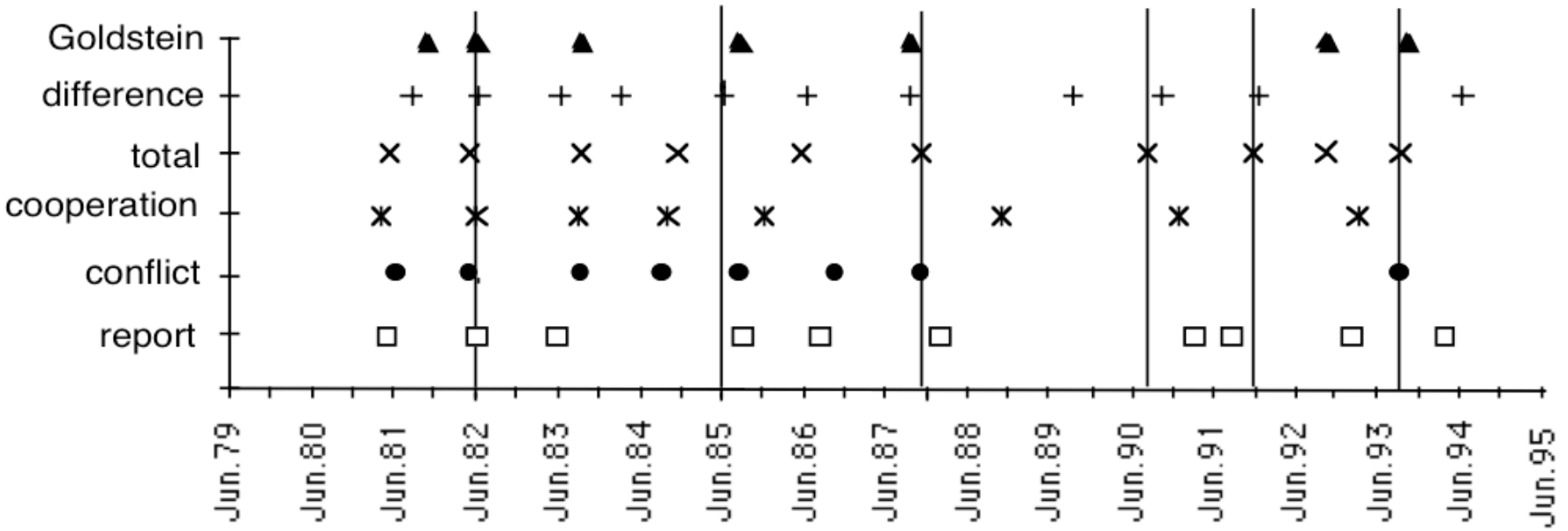
cooperation: cooperative event = 1; conflictual events = 0.

report: 1 if any event was reported in the month, 0 otherwise

Discriminant Analysis Results

Weighting scheme	%correct	variance explained	canonical correlation	Wilks' λ	significance	# factors
Goldstein	85.6%	76.3%	0.85	0.008	<.001	6
difference	89.7%	74.7%	0.85	0.007	<.001	7
total	94.4%	83.0%	0.93	0.001	<.001	6
conflict	88.2%	76.9%	0.86	0.007	<.001	6
cooperation	92.3%	82.2%	0.91	0.002	<.001	7
report	89.2%	73.6%	0.87	0.008	<.001	7
random date	61.0%	69.5%	0.66	0.131	.37	0
random dyad	57.4%	68.8%	0.67	0.119	.18	0

Cluster boundaries under various weighting systems



Why does detailed coding make so little difference?—sources of error in event data

- Reporting error
  - Missing events—limited reporting, censorship
  - False events—rumors and propaganda
- Coding error
  - Individual—coders are not correctly implementing the event coding system
  - Systemic—event coding system does not reflect political behavior
- Model specification
  - model may be using the wrong indicators
  - mathematical structure of the model does not produce good predictions
  - Models with diffuse information structures—neural networks, VAR, HMM—are good at adapting to missing information

Event Categories

- Verbal Cooperation: The occurrence of dialogue-based meetings (i.e. negotiations, peace talks), statements that express a desire to cooperate or appeal for assistance (other than material aid) from other actors. CAMEO categories 01 to 05.
- Material Cooperation: Physical acts of collaboration or assistance, including receiving or sending aid, reducing bans and sentencing, etc. CAMEO categories 06 to 09.
- Verbal Conflict: A spoken criticism, threat, or accusation, often related to past or future potential acts of material conflict. CAMEO categories 10 to 14.
- Material Conflict: Physical acts of a conflictual nature, including armed attacks, destruction of property, assassination, etc. CAMEO categories 15 to 20.

ICEWS Substate Actor Categories

- gov: government agents such as the executive, police, and military
- par: political parties
- opp: armed opposition---rebels and military groups
- soc: society in general---civilians, businesses, professional groups
- ios: international actors
- usa: United States

High-volume, near-real-time coding

- News sources from RSS feeds, news aggregators and other web-based sources
- These are relatively stable, but the formatters and downloading still need occasional updating
- Background processing for
  - Parsing
  - Location
  - Context
  - New actor/entity identification
  - Duplicate reports
- Recoding in cluster computing environment
  - ICEWS: 9-million stories can be recoded in about half an hour using a 12-node cluster

KEDS High-volume processing suite

- Objective: “embarrassingly parallel” processing on a cluster computer (i.e. just split and recombine the files)
- Tasks
- Sort multiple files into chronological order
- Duplicate detection
- Post-download filtering (particularly if using LN) and date-consistency checking (eliminates records with bad or out-of-range dates
- Create .project files which run with current version of TABARI in parallel mode
- Split file for coding, then recombine results into a single chronological sequence

New Directions in Automated Event Coding

- Pre-parsing

- Treatment of actors
- Contextual coding
- High-volume coding
- Server-based integration

Pre-parsing

- Use open-source linguistics tools—not the coding program—to handle most of the parsing tasks.
- http://incubator.apache.org/opennlp/}\footnote{Open-NLP is in the midst of a transition of sponsorship and this URL may change.}), GATE \\ http://gate.ac.uk/}), the University of Illinois Cognitive Computation Group \\ http://cogcomp.cs.illinois.edu/page/software}), the Stanford NLP Group \\ http://nlp.stanford.edu/software/index.shtml}) and various other academic sites. LingPipe's ``Competition'' page (\texttt{http://alias-i.com/lingpipe/web/competition.html})
  - Dictionaries would then be modified to use this information
- Parsing tasks
  - Entity identification/disambiguation
  - Parts of speech, particularly noun/verb disambiguation
  - Subject, verb and object phrase delineation
  - Pronoun coreferencing
- With sufficient information, coding becomes largely a bookkeeping problem: almost all of the knowledge is in the dictionaries

Actor Dictionaries

- mySQL DB contains multiple characteristics of the actor
  - Synonyms (“U.S.”, “American”), time-tagged roles, geolocation
- Dictionaries and coders built on the fly, depending of what information will be coded
- Instead of manual, supervised learning on the text, dictionaries developed using
  - Entity identification and coresolution software on the entire text base
  - External lists of actors, e.g. NGOs, rulers.org, CIA World Factbook

Contextual Coding

- Determine the context of the report from the complete story, rather than each individual sentence
- Location
  - Ideally to as much detail as possible, using gazetteers, most in the public domain
  - However, some stories do not have a location
  - Location can also be used to resolve agents
  - Resolves ambiguous common names and acronyms
- Better filtering of sports, business, entertainment and historical stories
- General categories and then the use of specialized dictionaries
  - For example “attack” has a different meaning depending on whether a story involved military action, debate or cyber-attack

Machine translation

- Possibility of event-specific additional coding, e.g. just do location for things with a location, get numbers of casualties, demonstrations

Questions?

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Some additional considerations

But Phil, the best models are classified!

- Hollywood tells me so
- Yeah, right…
- No systematic evidence of this: if it is true, government is spending vast resources to obscure this fact
- Clearly isn't operating at the policy level
- Probably some models have worked at some points in the past but they have not proven robust
  - Serious snake-oil sales going on here as well…
- Even if this is true, we need to reverse-engineer these to get them into the unclassified literature and acquaint policy-makers with the techniques
- [but it probably isn't true…]

What methods do *real* intelligence agencies use to predict political events?

"Two weeks ago, a group of senior intelligence officials in the [U.S.] Defense Dept. sat for an hour listening to a briefing by Michael Drosnin, who claims—I am not making this up—that messages encoded in the Hebrew text of the Old Testament provide clues to the whereabouts of Osama bin Laden. He has given similar briefings to top officials of Mossad, the Israeli intelligence agency."

Bill Keller
International Herald-Tribune, 8-9 March 2003, pg. 6

Easy Problems

Hard Problems