Text Categorization

(actually, methods apply for categorizing anything into fixed categories – tagging, WSD, PP attachment ...)

Why Text Categorization?

- Is it spam?
- Is it Spanish?
- Is it interesting to this user?
  - News filtering
  - Helpdesk routing
- Is it interesting to this NLP program?
  - e.g., should my calendar system try to interpret this email as an appointment (using info. extraction)?
- Where should it go in the directory?
  - Yahoo! / Open Directory / digital libraries
  - Which mail folder? (work, friends, junk, urgent ...)

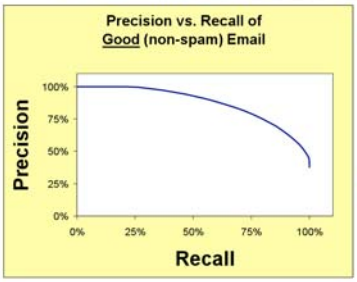
Measuring Performance

- Classification accuracy: What % of messages were classified correctly?
- **Is this what we care about?**

	Overall accuracy	Accuracy on spam	Accuracy on gen
System 1	95%	99.99%	90%
System 2	95%	90%	99.99%

- Which system do you prefer?

Measuring Performance

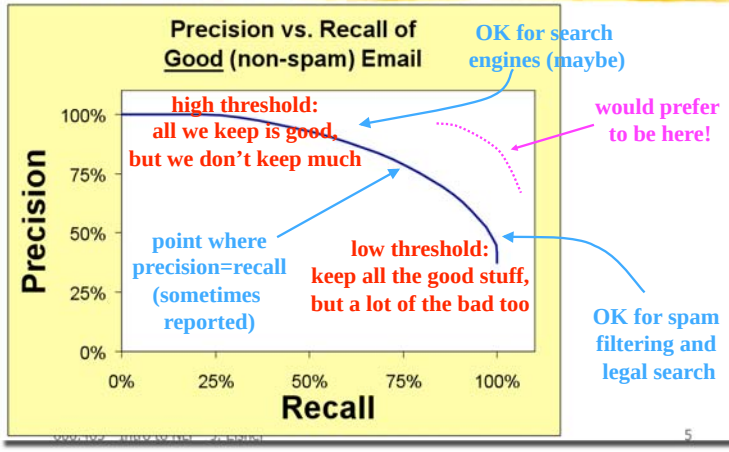


- Precision = $\frac{\text{good messages kept}}{\text{all messages kept}}$
- Recall = $\frac{\text{good messages kept}}{\text{all good messages}}$

Trade off precision vs. recall by setting threshold
Measure the curve on annotated dev data (or test data)
Choose a threshold where user is comfortable

F-measure = 1 / (average(1/precision, 1/recall))

Measuring Performance



More Complicated Cases of Measuring Performance

- For multi-way classifiers:
  - Average accuracy (or precision or recall) of 2-way distinctions: Sports or not, News or not, etc.
  - Better, estimate the cost of different *kinds* of errors
    - e.g., how bad is each of the following?
      - putting Sports articles in the News section
      - putting Fashion articles in the News section
      - putting News articles in the Fashion section
    - Now tune system to minimize total cost
- For ranking systems: Which articles are most Sports-like? Which articles / webpages most relevant?
  - Correlate with human rankings?
  - Get active feedback from user?
  - Measure user's wasted time by tracking clicks?

How to Categorize?

```
Subject: would you like to . . . .

. . drive a new vehicle for free ? ? ? this is not hype or a
hoax , there are hundreds of people driving brand new cars ,
suvs , minivans , trucks , or rvs . it does not matter to us
what type of vehicle you choose . if you qualify for our
program , it is your choice of vehicle , color , and
options . we don ' t care . just by driving the vehicle , you
are promoting our program . if you would like to find out
more about this exciting opportunity to drive a brand new
vehicle for free , please go to this site : http : / / 209 .
134 . 14 . 131 / ntr to watch a short 4 minute audio / video
presentation which gives you more information about our
exciting new car program . if you do n't want to see the
short video , but want us to send you our information package
that explains our exciting opportunity for you to drive a new
vehicle for free , please go here : http : / / 209 . 134 .
14 . 131 / ntr / form . htm we would like to add you the
group of happy people driving a new vehicle for free . happy
motoring .
```


How to Categorize? (supervised)

We've seen lots of options in this course!

1. Build n-gram model of each category
   - Question: How to classify test message?
   - Answer: Bayes' Theorem

How to Categorize? (supervised)

We've seen lots of options in this course!

2. Represent each document as a vector
   (must choose representation and distance measure; use SVD?)
   - Question: How to classify test message?
   - Answer 1: Category whose centroid is most similar
     (may not work well if category is diverse)
   - Answer 2: Cluster each category into subcategories
     (then use answer 1 to pick a subcategory)
     (return the category that the subcategory is in)
     (this can also be useful for n-gram models)
   - Answer 3: Just look at labels of nearby training docs
     (e.g., let the k nearest neighbors vote – flexible!)
     (maybe the closer ones get a bigger vote)

How to Categorize? (supervised)

We've seen lots of options in this course!

3. Treat it like word-sense disambiguation
   a) Vector model – use all the features (we just saw this)
   b) Decision list – use single most indicative feature
   c) Naive Bayes – use all the features, weighted by how well they discriminate among the categories
   d) Decision tree – use some of the features in sequence
   e) Other options from machine learning, like perceptron, Support Vector Machine (SVM), logistic regression, ...

Features matter more than which machine learning method

Review: Vector Model

These two documents are similar:
After normalizing vector length to 1,
Close in Euclidean space (similar endpoint)
High dot product (similar direction)

aardvark abacus abandoned abbot abduct above zygote zymurgy

(0, 0, 3, 1, 0, 7, . . . 1, 0)

(0, 0, 1, 0, 0, 3, . . . 0, 1)

Can play lots of encoding games when creating vector:
Remove function words or reduce their weight
Use features other than unigrams

slide courtesy of D. Yarowsky (modified)

Review: Decision Lists

To disambiguate a token of *lead* :
- Scan down the sorted list
- The first cue that is found gets to make the decision all by itself
- Not as subtle as **combining** cues, but works well for WSD

Cue's score is its log-likelihood ratio:
log [p(cue | sense A) [smoothed] / p(cue | sense B)]

Position	Collocation	led	li:d
+1 L	lead *level/N*	219	0
-1 W	*narrow* lead	0	70
+1 W	lead *in*	207	898
-1W +1W	*of* lead *in*	162	0

LogL	Evidence	Pronunciation
11.40	*follow/V* + lead	⇒ li:d
11.20	*zinc* (in ±*k* words)	⇒ led
11.10	lead *level/N*	⇒ led
10.66	*of* lead *in*	⇒ led
10.59	*the* lead *in*	⇒ li:d
10.51	lead *role*	⇒ li:d
10.35	*copper* (in ±*k* words)	⇒ led
10.28	lead *time*	⇒ li:d
10.24	lead *levels*	⇒ led
10.16	lead *poisoning*	⇒ led
8.55	*big* lead	⇒ li:d
8.49	*narrow* lead	⇒ li:d
7.76	*take/V* + lead	⇒ li:d
5.99	lead , *NOUN*	⇒ led
1.15	lead *in*	⇒ li:d
	∘∘∘	

slide courtesy of D. Yarowsky (modified)

Review: Combining Cues via Naive Bayes

Authorship ID: Who Wrote a Student's Term Paper?

Word in Text	Frequency as Student A	Frequency as Student B
optimally	97	1
certainly	84	3
typically	46	4
perspicuous	26	0
actually	13	4
whilst	6	0
the	241	229
awesome	0	63
totally	0	40
wonderful	0	26
incredibly	0	13

these stats come from term papers of *known* authorship

(i.e., supervised training)

$$\frac{P(optimally|StudentA)}{P(optimally|StudentB)} = \frac{97}{1} \qquad \frac{P(the|StudentA)}{P(the|StudentB)} = \frac{1.1}{1}$$

slide courtesy of D. Yarowsky (modified)

Review: Combining Cues via Naive Bayes

$$\frac{P(optimally|StudentA)}{P(optimally|StudentB)} = \frac{97}{1} \qquad \frac{P(the|StudentA)}{P(the|StudentB)} = \frac{1.1}{1}$$

$$\frac{P(awesome|StudentA)}{P(awesome|StudentB)} = \frac{0}{63}$$

$$\frac{P(StudentA)}{P(StudentB)} \times \frac{P(w_1|StudentA)}{P(w_1|StudentB)} \times \frac{P(w_2|StudentA)}{P(w_2|StudentB)} \times \ldots$$

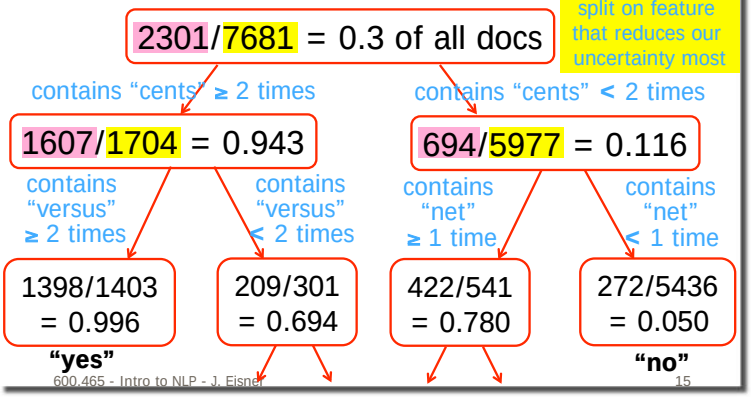
"Naive Bayes" model for classifying text
(Note the naive independence assumptions!)

Would this kind of sentence be more typical of a student A paper or a student B paper?

example from Manning & Schütze

Decision Trees

Is this Reuters article an Earnings Announcement?



Features Besides Unigrams

- All these approaches (except n-gram model) can use "interesting" features, not just unigrams.
- There's generally a heuristic feature selection problem
  - Use some very large set of features defined by a template
  - Maybe restrict to features that look useful in isolation?
  - Add features greedily, one at a time
    - Measure or guess expected improvement of each feature
    - Make sure to smooth when doing this – why?
  - At the end, remove features that hurt performance on held-out data
- What does SpamAssassin use?

SpamAssassin Features

100	From: address is in the user's black-list
4.0	Sender is on www.habeas.com Habeas Infringer List
3.994	Invalid Date: header (timezone does not exist)
3.970	Written in an undesired language
3.910	Listed in Razor2, see http://razor.sf.net/
3.801	Subject is full of 8-bit characters
3.472	Claims compliance with Senate Bill 1618
3.437	exists:X-Precedence-Ref
3.371	Reverses Aging
3.350	Claims you can be removed from the list
3.284	'Hidden' assets
3.283	Claims to honor removal requests
3.261	Contains "Stop Snoring"
3.251	Received: contains a name with a faked IP-address
3.250	Received via a relay in list.dsbl.org
3.200	Character set indicates a foreign language

SpamAssassin Features

3.198	Forged eudoramail.com 'Received:' header found
3.193	Free Investment
3.180	Received via SBLed relay, seehttp://www.spamhaus.org/sbl/
3.140	Character set doesn't exist
3.123	Dig up Dirt on Friends
3.090	No MX records for the From: domain
3.072	X-Mailer contains malformed Outlook Expressversion
3.044	Stock Disclaimer Statement
3.009	Apparently, NOT Multi Level Marketing
3.005	Bulk email software fingerprint (jpfree) found inheaders
2.991	exists:Complain-To
2.975	Bulk email software fingerprint (VC_IPA) found inheaders
2.968	Invalid Date: year begins with zero
2.932	Mentions Spam law "H.R. 3113"
2.900	Received forged, contains fake AOL relays
2.879	Asks for credit card details

SpamAssassin Features

2.858 To: username at front of subject
2.851 Claims you actually asked for this spam
2.842 To header contains 'recipient' marker
2.826 Compare Rates
2.800 Received: says mail bounced all around the world
2.800 Mentions Spam Law "UCE-Mail Act"
2.796 Received via buggy SMTP server (MDaemon2.7.4SP4R)
2.795 Bulk email software fingerprint (StormPost) foundin headers
2.786 Broken CGI script message
2.784 Message-Id generated by a spam tool
2.783 Urges you to call now
2.782 Tells you it's an ad
2.782 RAND found, spammer forgot to run the random-IDgenerator
2.748 Cable Converter
2.744 No Age Restrictions
2.737 Possible porn - Celebrity Porn

SpamAssassin Features

2.782 Tells you it's an ad
2.782 RAND found, spammer forgot to run the random-IDgenerator
2.748 Cable Converter
2.744 No Age Restrictions
2.737 Possible porn - Celebrity Porn
2.735 Bulk email software fingerprint (JiXing) found inheaders
2.730 DNSBL: sender is Confirmed Spam Source
2.726 Bulk email software fingerprint (MMailer) found inheaders
2.720 exists:X-Encoding
2.720 DNSBL: sender is Confirmed Open Relay
2.702 SEC-mandated penny-stock warning -- thanks SEC
2.695 Claims you can be removed from the list
2.693 Removes Wrinkles
2.668 Offers a stock alert
2.660 Listed in DCC, seehttp://rhyolite.com/anti-spam/dcc/
2.658 Common pyramid scheme phrase (1)

SpamAssassin Features

2.654 Offers a free consultation
2.645 Bulk email software fingerprint (EVAMAIL) foundin headers
2.642 Possible porn - Amateur Porn
2.640 Listed in Razor1, see http://razor.sf.net/
2.639 Subject contains lots of white space
2.622 exists:X-x
2.620 Received via a relay in relays.visi.com
2.611 Bulk email software fingerprint (IMktg) found inheaders
2.566 Compete for your business
2.565 Possible porn - Pay Site
2.541 Contains "CBYI"
2.516 Spam phrases score is 34 to 55 (high)
2.513 Possible porn - Lesbian Site
2.510 Contains 'free installation' with capitals
2.502 Free Grant Money
2.500 Listed in Pyzor, see http://pyzor.sf.net/

SpamAssassin Features

2.500 Tre¶æ zawiera 'odes³anie z dopiskiem NIE'
2.500 Tre¶æ zawiera 'Artykul 25 ust 2 punkt 2'
2.500 Tresc zawiera 'przepraszamy za zajêty czas'
2.500 Tresc zawiera 'Zamów teraz!!!'
2.500 Tresc zawiera 'Je¿eli (Pañstwo) nie ¿yczycie(sz)sobie'
2.500 Tresc zawiera 'Aby usun±æ adres e-mail...'
2.496 Spam tool pattern in MIME boundary
2.492 'Message-Id' was added by a relay
2.488 Bulk email software fingerprint (screwup 1) found inheaders
2.456 University Diplomas
2.450 Character set indicates foreign language body
2.445 Claims you can be removed from the list
2.443 Headers include 3 consecutive 8-bit characters
2.425 Date: is 24 to 48 hours after Received: date
2.421 'From' juno.com does not match 'Received' headers
2.398 Meet Singles

SpamAssassin Features

2.362 Serious Enquiries Only.
2.361 Claims auto-email removal
2.357 MiME-Version header (oddly capitalized)
2.357 A "microsoft" header was found
2.351 X-Mailer contains "OutLook Express 3.14159"
2.334 Possible porn - Rape
2.331 "Collect Child Support" Scam
2.314 Claims spam helps the environment
2.292 Free Leads
2.290 Fake name used in SMTP HELO command
2.280 Received via a relay in ipwhois.rfc-ignorant.org
2.276 Possible porn - Cum Shot
2.261 Amazing Stuff
2.250 Received via a relay in orbs.dorkslayers.com
2.242 Possible porn - Mega Porn
2.240 Offers pure profit

SpamAssassin Features

2.216 Received contains a faked HELO hostname
2.210 Tells you it's an ad
2.209 Uses control sequences inside a URL's hostname
2.206 Claims spam helps the environment
2.203 Tells you to 'take action now!'
2.203 Cash Bonus
2.202 From an address @btamail.net.cn
2.180 exists:X-Library
2.176 Contains "My wife, Jody" testimonial
2.170 Possible porn - Nasty Girls
2.145 Promise you ...!
2.114 Claims to be in accordance with some Spam law
2.109 Uses a numeric IP address in URL
2.100 Possible porn - Live Porn
2.088 Discusses search engine listings
2.083 HTML comments which obfuscate text

SpamAssassin Features

2.066	Information on getting a larger penis or breasts (2)
2.066	Contains 'free preview' with capitals
2.060	A foreign language charset used in headers
2.052	Says "We strongly oppose the use of spam email"
2.044	trail of Received: headers seems to be forged
2.030	Credit Bureaus
2.022	Claims compliance with House Bill 4176
2.011	No Investment
2	Tre¶æ zawiera 'adres e-mail zostalznaleziony/pozyskany'
2	Tre¶æ zawiera 'adres (e-mail) pochodzi zogólnodostêpnych....'
2	Tre¶æ zawiera 'Ustawy o ochronie danychosobowych'
2	Tresc zawiera 'temat USUN'
2	Tresc zawiera 'na podstawie adresow e-mailpublicznie...'
2	Tresc zawiera 'kliknij w poni¿szy link'
2	Tresc zawiera 'do nabycia u nas'
2	Tresc zawiera 'Wys³aæ pusty mail'

SpamAssassin Features

2	Tresc zawiera 'Wiadomo¶æ nadano na podstawie...'
2	Tresc zawiera 'Wiadomo¶æ nadano jednorazowo...'
2	Tresc zawiera 'USUN Z BAZY'
2	Tresc zawiera 'Prosimy o przes³anie pustego maila'
2	Tresc zawiera 'Je¿eli nie interesuj±...'
2	Tresc zawiera 'Je¿eli nie chcesz (otrzymywac)...'
2	Tresc zawiera '...prosimy o zwrotny e-mail...'
2	Tresc zawiera '...adres z bazy...'
2	Dice cumplir con la ley
2	Clama cumplir con la normativa SPAM
1.995	Serious cash
1.984	Viagra and other drugs
1.977	If only it were that easy
1.952	Nigerian scam key phrase (million dollars)
1.910	Drastically Reduced
1.904	Contains "Temple Kiff"

SpamAssassin Features

1.889	Forged 'by gw05' 'Received:' header found
1.889	Credit Card Offers
1.880	Find out Anything
1.858	Contains "Gentle Ferocity"
1.856	Spam phrases score is 21 to 34 (high)
1.844	Possible Porn - Porn membership
1.842	Potential Earnings
1.839	Bulk email software fingerprint (Group Mail) foundin headers
1.836	Once in a lifetime, apparently
1.831	Offers Free (often stolen) Passwords
1.824	Contains 'Dear (something)'
1.813	Possible porn - Porn Password
1.778	Message is 90-100% HTML tags
1.772	Sent using a trial version of CommuniGate
1.754	Date: is 48 to 96 hours after Received: date
1.744	To: has no local-part before @ sign

SpamAssassin Features

1.739	Talk about a check or money order
1.721	Contains 'for only pennies a day'
1.697	Spam tool pattern in MIME boundary
1.690	Form for checking email address
1.687	Subject: contains advertising tag
1.686	Talks about bulk email
1.682	Claims you registered with some kind of partner
1.681	Long Distance Phone Offer
1.663	Additional Income
1.640	Spam phrases score is 05 to 08 (medium)
1.640	Contains 'subject to credit approval'
1.639	Talks about tracing by SSN
1.631	Possible Porn - XXX Photos
1.625	Contains 'earn (dollar) something per week'
1.598	Message-Id has characters often found in spam
1.591	'X-Mailer' line contains gibberish

SpamAssassin Features

1.591	Cures Baldness
1.578	Subject starts with "Hello"
1.552	"Refinance your home"
1.548	Doing something with my income
1.546	Date: is 96 hours or more before Received: date
1.544	To: address contains spaces
1.539	Cents on the Dollar
1.526	Uses a username in a URL
1.523	Secretly Recorded
1.518	Invalid Date: header (not RFC 2822)
1.506	From and To are same (3)
1.505	Valid-looking To "undisclosed-recipients"
1.503	exists:Date-warning
1.500	Temat zawiera 'oferta'
1.500	Tre¶æ zawiera 'Zaprosiæ pañstwo'
1.500	Tre¶æ zawiera 'Szanowni Pañstwo'

SpamAssassin Features

1.500	Tresc zawiera 'publicznie dostêpny (email)'
1.500	Tresc zawiera 'Upowaznienie do wystawiania fakturVAT...'
1.500	Tresc zawiera '...mail z tematem...'
1.495	Possible registry spammer
1.490	Possible porn - Adult Web Sites
1.486	'one time mailing' doesn't mean it isn't spam
1.479	Forged hotmail.com 'Received:' header found
1.470	Talks about opting in
1.466	Possible porn - Barely Legal
1.459	Claims compliance with Senate Bill 1618
1.435	Direct Marketing
1.410	Money back guarantee.
1.404	Date: is 48 to 96 hours before Received: date
1.404	Instructions on how to increase something
1.400	NOS CHILLAN PARA DECIR QUE ES GRATIS
1.394	Plugs Viagra

SpamAssassin Features

1.385	Spam phrases score is 08 to 13 (medium)
1.382	URL uses words and phrases which indicate porn (4)
1.373	As seen on national TV!
1.370	Message text disguised using base-64 encoding
1.368	Date: is 3 to 6 hours after Received: date
1.363	Score with babes!
1.361	From and To are same (6)
1.352	'From' yahoo.com does not match 'Received' headers
1.337	Spam phrases score is 13 to 21 (high)
1.332	Not intended for residents of XYZ.
1.319	Faked To "Undisclosed-Recipients"
1.314	From and To are same (5)
1.306	Only thing addresses on CD are useful for is spam
1.302	Contains "Vjestika Aphrodisia"
1.301	Lower Monthly Payment
1.293	HTML comment has 3 consecutive 8-bit characters

SpamAssassin Features

1.285	From: does not include a real name
1.283	Uses a dotted-decimal IP address in URL
1.275	Contains link without http:// prefix
1.274	'Subject' contains G.a.p.p.y-T.e.x.t
1.273	Marketing Solutions
1.270	Spam tool pattern in MIME boundary
1.269	'Prestigious Non-Accredited Universities'
1.253	Spam tool pattern in MIME boundary
1.253	Incorporates a tracking ID number
1.247	From and To are same (2)
1.246	Contains 'free sample' with capitals
1.231	Claims compliance with spam regulations
1.226	Online Pharmacy
1.224	Received via SMTPD32 server (SMTPD32-n.n)
1.218	Includes a form which will send an email
1.201	While you Sleep

SpamAssassin Features

1.187	Uses non-standard port number for HTTP
1.175	Possible porn - in ALL CAPS
1.148	Subject contains a unique ID
1.146	Bulk email software fingerprint (hash 2) found inheaders
1.138	Get Paid
1.131	Contains 'URGENT BUSINESS'
1.119	Why Pay More?
1.118	Requires Initial Investment
1.112	Javascript to open a new window
1.110	exists:X-List-Unsubscribe
1.099	Date: is 6 to 12 hours after Received: date
1.098	Subject starts with dollar amount
1.092	Increase your ejaculation!
1.084	Subject: contains Korean unsolicited email tag
1.084	Spam phrases score is 03 to 05 (medium)
1.078	Plugs "Herbal Viagra"

SpamAssassin Features

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1.175	Possible porn - in ALL CAPS
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1.084	Subject: contains Korean unsolicited email tag
1.084	Spam phrases score is 03 to 05 (medium)
1.078	Plugs "Herbal Viagra"

SpamAssassin Features

1.077	Apparently, you'll be amazed
1.057	People just leave money laying around
1.045	Bulk email software fingerprint (eGroups) found inheaders
1.042	Date: is 24 to 48 hours before Received: date
1.039	Talks about direct email
1.038	Unneeded encoding of HTML tags
1.023	Javascript to move windows around
1.021	No such thing as a free lunch (3)
1.009	Save big money
1	Frequent SPAM content
1	Frequent SPAM content
1	Frequent SPAM content
1	Frequent SPAM content
1	Frequent SPAM content
1	Frequent SPAM content
1	Frequent SPAM content

SpamAssassin Features

1	Filename is just a '\#'; probably a JS trick
1	Old Murkowski disclaimer
1	Obfuscated action attribute in HTML form
1	Mentions monsterhut.com
1	Form for verifying email address
1	Contains signature of unregistered spam tool
1	Publicidad por e-mail
1	Contiene la palabra gratis en las cabeceras
1	exists:X-Fix
1	To: non-existent 'Investors' address
1	Subject contains 'Your Membership Exchange'
1	Spam tool pattern in MIME boundary
1	Reply-To: is empty
1	Received via a relay in bl.spamcop.net
1	Received via RSSed relay, seehttp://www.mail-abuse.org/rss/
1	Received via RBLed relay, seehttp://www.mail-abuse.org/rbl/

SpamAssassin Features

1 Received from first hop dialup, seehttp://www.mail-abuse.org/dul/
1 Received from dialup, seehttp://www.mail-abuse.org/dul/
1 Received contains fake 'Post.cz' hostname
1 From an address @email-publisher.com
1 Bulk email software fingerprint (xmailer tag) foundin headers
1 Bulk email software fingerprint (pascual) found inheaders
1 Bulk email software fingerprint (eBizmailer) foundin headers
1 Bulk email software fingerprint (charset) found inheaders
1 Bulk email software fingerprint (Yam) found inheaders
1 Bulk email software fingerprint (V3161) found inheaders
1 Bulk email software fingerprint (Uproar) found inheaders
1 Bulk email software fingerprint (Seednet) found inheaders
1 Bulk email software fingerprint (PowerCampaign)found in headers
1 Bulk email software fingerprint (Opt-In Lightning)found in headers
1 Bulk email software fingerprint (Matchmaker) foundin headers
1 Bulk email software fingerprint (Mail Bomber)found in headers

SpamAssassin Features

1 Bulk email software fingerprint (Henry Su) found inheaders
1 Bulk email software fingerprint (GRMessageQueue)found in headers
1 Bulk email software fingerprint (EPaper) found inheaders
1 Bulk email software fingerprint (DiffondiCool)found in headers
1 Bulk email software fingerprint (CurrentMailer)found in headers
1 Bulk email software fingerprint (Caretop) found inheaders
1 Bulk email software fingerprint (Campaign Blaster)found in headers
1 Bulk email software fingerprint ("outlook") found inheaders
1 'Received:' contains huge hostname
1 'From' contains more than one address
1 Tre¶æ jest od wydawnictwa Verlag Dashofer(spamerzy)
1 Tresc zawiera 'Za zaliczeniem pocztowym...'
1 /zam.wieni/i
1 /zainteresowan.{0,50}wsp..prac/
1 /www\.adresy\.org/i
1 /specjaln.{0,50}ofert/i

SpamAssassin Features

1 Presentación de un nuevo producto.
1 Porno gratis.
1 Para dejar de fumar
1 Pago contra reembolso.
1 Nos animan a contestar si estamos interesados
1 No se puede considerar spam
1 Mensaje enviado por error
1 Mas informacion.
1 Los regalos no existen, salvo de nuestros amigos.
1 Inmigración legal (?) a los Estados Unidos
1 Informacion y reserva
1 If you want to subscribe...
1 If you send an email you will be OptOut
1 IMPERATIVOS EN MAYUSCULAS.
1 Haga click aqui.
1 Ha sido ganador.

SpamAssassin Features

1 Ha sido ganador.
1 El correo como alternativa comercial
1 Conviertete en Spammer.
1 Claims you can opt-out
1 Claims you can be removed in Spanish
1 Claims not to be spam in Spanish
1 Alta en buscadores hispanos.
1 spam software: PopLaunch
1 mentions Cyber FirePower!, a spam-tool
1 Will not Belive your Eyes!
1 Well known spam senders
1 Wants you to do business online
1 Things incredible
1 They keep your money -- No Refund!
1 Terms and conditions
1 Suspect you might have received the message bymistake

SpamAssassin Features

1 Slashed Price
1 SSPL found, spammer forgot to run the random-IDgenerator
1 Psychics Scam
1 Prices won't Last
1 Possible porn - Galleries of Pictures
1 Plugs "Natural Viagra"
1 Outstanding Values
1 Orders shipped by priority mail
1 No Middleman
1 No Medical Exams
1 No Gimmick
1 Nigerian scam, cfhttp://www.snopes2.com/inboxer/scams/nigeria.htm
1 New Customers Only
1 More Internet Traffic
1 Luxury Car
1 List removal information

SpamAssassin Features

1 Get Started Now
1 Cyber FirePower! rant about losing dropboxes
1 Confidentially on all orders
1 Claims you were on a list
1 Claims to listen to some removal request list
1 Claims not to be spam
1 Claims not to be selling anything
1 Claims compliance with spam regulations
1 Claims compliance with spam regulations
1 Claims "This is not junk email"
1 Cell Phone Cancer Scam
1 Buying judgements
1 Achieve Wealth
0.982 Talks about future mailings
0.977 Excessive quoted-printable encoding in body
0.975 Multi Level Marketing mentioned

SpamAssassin Features

0.968	Possible porn - Hardcore Porn
0.959	Missing To: header
0.954	From: has no local-part before @ sign
0.952	Targeted Traffic / Email Addresses
0.948	Information on getting a larger penis or breasts
0.947	Message is 70-90% HTML tags
0.935	Free Membership
0.931	To: and Cc: contain similar domains at least 8 times
0.910	Received contains a (dollar) variable reference
0.908	Claims compliance with spam regulations
0.906	'From' ebay.com does not match 'Received' headers
0.904	Unlimited in caps
0.900	Accept Credit Cards
0.893	From: ends in numbers
0.885	'Message-Id' was added by a relay (3)
0.882	Gives information about an opportunity

SpamAssassin Features

0.874	Don't delete me! Nooooo!!!!
0.863	Fast Viagra Delivery
0.853	Frequent SPAM content
0.849	exists:X-Stormpost-To
0.849	Missing Date: header
0.849	List removal information
0.838	Consolidate Debt and Credit
0.820	Financial Freedom
0.817	Lots and lots of Cc: headers
0.810	Received via a relay in multihop.dsbl.org
0.796	Contains word 'guarantee' in all-caps
0.795	Claims you can be removed from the list
0.781	Spam phrases score is 00 to 01 (low)
0.781	HTML message is a saved web page
0.781	Claims compliance with Senate Bill 1618
0.779	exists:X-PMFLAGS

SpamAssassin Features

0.676	See for yourself
0.673	You'd better read all of this spam!
0.670	Easy Terms
0.666	Contains "Toner Cartridge"
0.665	Human Growth Hormone
0.658	Trying to sell insurance online
0.653	No experience needed!
0.646	Claims to be legitimate email
0.643	Subject: starts with advertising tag
0.630	Frequent SPAM content
0.628	illegal Nigerian transactions (2)
0.622	Subject GUARANTEED
0.620	DNSBL: sender ip address in in a dialup block
0.614	Possible porn - Must be 18
0.612	Tells you to click on a URL (in caps)
0.612	Free Quote

SpamAssassin Features

0.611	Refinance Home
0.610	Received via a relay in relays.ordb.org
0.608	Contains 'free access' with capitals
0.606	Uses a long numeric IP address in URL
0.605	Have you been turned down?
0.601	Includes a URL link to send an email with the subject'remove'
0.601	No Credit Check
0.600	No Inventory
0.594	To: has a malformed address
0.573	Be your own boss
0.563	Information on how to work at home (2)
0.560	Contains mail-in order form
0.556	One hundred percent guaranteed
0.553	Guaranteed Stuff
0.552	Information on mortgage rates
0.549	Frequent SPAM content

SpamAssassin Features

0.544	From and To the same (1)
0.542	Bulk email software fingerprint (screwup 2) found inheaders
0.542	Gives an excuse for why message was sent
0.541	Avoid Bankruptcy
0.539	Includes a link for AOL users to click
0.536	Form for changing email address
0.531	Apply online (with capital O)
0.525	List removal information
0.521	Date: is 12 to 24 hours after Received: date
0.518	Asks you for your signature on a form
0.514	Subject talks about losing pounds
0.513	Lower Interest Rates
0.511	Do it Today
0.506	Unsecured Credit/Debt
0.506	The best Rates
0.505	From: starts with nums

SpamAssassin Features

0.505	Spam phrases score 55 or higher (high)
0.505	Impotence cure
0.503	Vacation Offers
0.503	Spam is 100% natural?!
0.501	Possible porn - Free Porn
0.501	Possible porn - Best, Largest Porn Collections
0.500	Spam phrases score is 01 to 02 (low)
0.496	Can not be combined with any other offer
0.489	Message contains disclaimer
0.488	Claims to be Legal
0.483	Subject is all capitals
0.466	MS-Outlook-style To "<Undisclosed-Recipient:;>"
0.466	Date: is 96 hours or more after Received: date
0.459	Spam tool pattern in MIME boundary
0.448	Date: is 6 to 12 hours before Received: date
0.448	Says: "to be removed, reply via email" or similar

SpamAssassin Features

0.448	Possible porn - Porn Fest
0.446	Sent with 'X-Priority' set to high
0.443	Local part containing a "4u" variant
0.443	HTML font color is magenta
0.435	Join Millions of Americans
0.434	Asks for a billing address
0.431	Nigerian scam key phrase ((dollar) NNN.Nm/USDNNN.N m/US(dollar) I
0.431	Claims "This is not spam"
0.429	Sent with 'X-Msmail-Priority' set to high
0.428	Subject contains "FREE" in CAPS
0.426	exists:X-MailingID
0.424	MIME section missing boundary
0.424	Asks you to fill out a form
0.422	HTML font color is unknown to us
0.422	Domain name containing a "4u" variant
0.421	HTML font color is yellow

SpamAssassin Features

0.419	Includes a link to send a mail with a subject
0.419	Standard investment opportunity spam
0.418	Javascript to hide URLs in browser
0.417	Offers Extra Cash
0.416	Eliminate Bad Credit
0.415	Lose Weight Spam
0.414	Subject talks about savings
0.414	Subject ends with lots of white space
0.414	Offers a full refund
0.414	Gives instructions for removal from list
0.413	Free Cell Phone
0.412	Frontpage used to create the message
0.411	Offers a limited time offer
0.410	Claims you can be removed from the list
0.408	Attempt at obfuscating the word "mortgage"
0.407	Opportunity - What a deal!

SpamAssassin Features

0.407	Nobody's perfect
0.406	Tells you about a strong buy
0.406	HTML table has thick border
0.406	Buy Direct
0.405	Instant Access button
0.405	HTML font color is green
0.405	HTML font color is cyan
0.405	Discusses money making
0.405	Asks you to click below (in caps)
0.404	Uses open redirection service
0.404	exists:X-ServerHost
0.404	Claims you can be removed from the list
0.403	List removal information
0.402	Message with extraneous Content-type:...type=header
0.402	There is no obligation.
0.402	Talks about lots of money

SpamAssassin Features

0.402	Contains 'Get it now' with capitals
0.401	Supplies are Limited
0.401	No such thing as a free lunch (2)
0.400	You won't be dissapointed.
0.400	Possible porn - Offers Instant Access
0.400	Nigerian scam key phrase ((dollar)NN,NNN,NNN.NN)
0.400	How dear can you be if you don't know my name?
0.386	No Strings Attached
0.382	HTML with embedded plugin object
0.380	Received via a relay in relays.osirusoft.com
0.369	Off Shore Scams
0.365	Information on how to work at home (1)
0.364	Possible porn - Hot, Nasty, Wild, Young
0.364	Contains word 'amazing' in all-caps
0.362	exists:X-SMTPExp-Version
0.362	There is no catch.

SpamAssassin Features

0.361	sent to you@you.com or similar
0.360	Received from first hop dialup listed inrelays.osirusoft.com
0.344	HTML font color is same as background
0.336	Subject: is empty or missing
0.335	FONT Size +2 and up or 3 and up
0.334	Lowest Price
0.333	HTML font color has unusual name
0.333	Contains word 'profits' in all-caps
0.330	HTML font color is gray
0.329	What are you waiting for
0.329	One Time Rip Off
0.327	Talks about prizes
0.327	Free Website
0.326	To: and Cc: contain similar usernames at least 5 times
0.325	HTML font face is not a commonly used face
0.324	Quoted-printable line longer than 76 characters

SpamAssassin Features

0.324	From: has a malformed address
0.323	exists:X-SMTPExp-Registration
0.323	Message-Id has no @ sign
0.323	No such thing as a free lunch (1)
0.321	URL of CGI script called "unsubscribe" or "remove"
0.321	Satisfaction Guaranteed
0.321	"if you do not wish to receive any more"
0.320	Message contains a lot of ^M characters
0.320	exists:x-esmtp
0.320	Claims you are a winner
0.319	From: contains numbers mixed in with letters
0.318	Can't live without?
0.317	HTML mail with non-white background
0.315	Talks about email marketing
0.315	Save big money
0.315	HTML font color is red

SpamAssassin Features

0.315	3 WHOLE LINES OF YELLING DETECTED
0.313	Save Up To
0.313	Domain registration spam body
0.312	Tells you to click on a URL
0.312	Subject: domain registration spam subject
0.308	URL contains spamhaus signature: numbered servers
0.308	Name Brand
0.307	Asks you to click below
0.307	Act Now! Don't Hesitate!
0.306	Talks about Hidden Charges
0.305	Message is 50-70% HTML tags
0.304	While Supplies Last
0.302	Easily-executed JavaScript code
0.302	Subject starts with "Free"
0.302	HTML font color not within safe 6x6x6 palette
0.301	No Purchase Necessary

SpamAssassin Features

0.301	Auto-executing JavaScript code
0.300	DNSBL: sender is a Spamware site or vendor
0.300	Significant Savings
0.300	No Fees
0.300	Click-to-remove with PHP/ASP action found
0.299	X-Mailer header indicates a non-spam MUA (TheBat!)
0.296	'remove' URL contains an email address
0.294	Being a Member
0.281	Investment Decision
0.279	Date: is 3 to 6 hours before Received: date
0.245	Contains a Privacy Statement
0.242	Tells you how to stop further spam
0.239	Month Trial Offer
0.229	Save (dollar) (dollar) (dollar)
0.224	Sign up Free Today
0.222	To: repeats address as real name

SpamAssassin Features

0.218	Congratulations - you've been scammed?
0.217	2 WHOLE LINES OF YELLING DETECTED
0.216	Weekend Getaway
0.214	Trying to offer you something
0.212	Member Stuff
0.212	HTML font color is missing hash (
0.212	Doesn't ask any questions
0.212	Contains 'Special Promotion'
0.212	A WHOLE LINE OF YELLING DETECTED
0.211	To: is empty
0.211	Winning in Caps
0.211	Stuff on Sale
0.211	Only (dollar) (dollar) (dollar)
0.211	Encourages you to waste no time in ordering
0.210	Who really wins?
0.210	HTML font face has excess capital characters

SpamAssassin Features

0.209	Free DVD
0.207	Date: is 12 to 24 hours before Received: date
0.207	JavaScript code
0.206	Header with all capitals found
0.205	HTML font color is blue
0.204	Winner in Caps
0.204	HTML font face is not a word
0.204	Fantastic Deal
0.203	Includes a 'remove' email address
0.203	Includes a URL link to send an email
0.203	Possible porn - Large Number of movies, pics
0.203	Free Offer
0.202	Contains a tollfree number
0.201	illegal Nigerian transactions (1)
0.201	Image tag with an ID code to identify you
0.201	Frame wanted to load outside URL

SpamAssassin Features

0.201	Contains 'for only' some amount of cash
0.181	X-Mailer header indicates a non-spam MUA(Outlook Express)
0.150	Spam tool pattern in MIME boundary
0.146	Cancel at any time!
0.144	Talks about social security numbers
0.137	Click to perform an action on an account
0.134	Gives an excuse about why you were sent this spam
0.127	Nigerian scam key phrase ((dollar) NNN.Nm/USDNNN.N m/US(dollar) l
0.123	Contains a comment with nothing but unique ID
0.117	No Claim Forms
0.114	'Message-Id' was added by a relay (2)
0.114	Free Trial
0.111	They're just giving it away!
0.108	Message-Id has characters indicating spam
0.107	Dear you@you.com?
0.106	Free Hosting

SpamAssassin Features

0.105	Contains an ASCII-formatted form
0.104	I wonder how many emails they sent in error...
0.103	URL of page called "unsubscribe"
0.102	Subject has exclamation mark and question mark
0.101	Offer Expires
0.101	Contains 'Dear Somebody'
0.100	Javascript protocol in a URI
0.100	Message includes Microsoft executable program
0.100	MIME filename does not match content
0.100	Spam tool pattern in MIME boundary
0.038	'Received:' has 'may be forged' warning
0.032	Message-Id is not valid, according to RFC 2822
0.031	Offers Coupon
0.028	Please read this! Please oh please oh please!
0.014	Shopping Spree
0.009	Contains a line >=199 characters long

SpamAssassin Features

0.009	Spam tool pattern in MIME boundary
0.009	Risk free. Suuurreeee....
0.008	Reserves the right
0.008	Expect to earn
0.005	Contains 'G.a.p.p.y-T.e.x.t'
0.004	Gift Certificate
0.003	Big Bucks
-0.006	X-Mailer header indicates a non-spam MUA(Outlook)
-0.019	From Majordomo
-0.026	Missing From: header
-0.069	Free money!
-0.075	Forwarded email (Outlook style)
-0.102	Email came from some known mailing list software
-0.118	Mailer daemon failure notice (1)
-0.123	Message text is over 40K in size
-0.133	Came via Internet Mail Service plugin

SpamAssassin Features

-0.137	Correct for MIME 'null block'
-0.143	X-Mailer header indicates a non-spam MUA(Netscape)
-0.196	Mailing list headers are suspicious
-0.200	exists:Resent-To
-0.207	exists:X-Authentication-Warning
-0.211	Where are you working at?
-0.215	exists:X-Accept-Language
-0.217	Subject contains newsletter header (list)
-0.231	'Message-Id' was added by yahoo.com, that's OK
-0.233	exists:X-Loop
-0.240	X-Mailer header indicates a non-spam MUA (AOL)
-0.298	To: repeats local-part as real name
-0.300	User-Agent header indicates a non-spam MUA(Entourage)
-0.301	Short signature present (no empty lines)
-0.302	exists:X-Mailing-List
-0.304	Long signature present (empty lines)

SpamAssassin Features

-0.484	Subject contains a month name - probable newsletter(2)
-0.484	Subject contains a month name - probable newsletter
-0.489	Common footer for Hotmail
-0.506	Contains a PGP-signed message
-0.506	Appears to be from yahoo groups
-0.506	Yahoo! Groups message
-0.518	exists:User-Agent
-0.522	Has a valid-looking References header
-0.558	Forwarded email
-0.601	User-Agent header indicates a non-spam MUA(Mozilla)
-0.605	User-Agent header indicates a non-spam MUA(Outlook Express)
-0.616	Subject contains newsletter header (news)
-0.641	Message-Id indicates a non-spam MUA (Pine)
-0.695	Contains what looks like an 'E-Mail Disclaimer'
-0.708	Contains a PGP-signed message (signature attached)
-0.708	Message text is over 20K in size

SpamAssassin Features

-0.725	Subject contains a frequency - probable newsletter
-0.754	X-Mailer header indicates a non-spam MUA(T-Offline)
-0.832	Contains what looks like a quoted email text
-0.847	exists:In-Reply-To
-0.864	Has an Approved-By moderated list header
-0.897	User-Agent header indicates a non-spam MUA(IMP)
-0.949	Contains what looks like a patch from diff -u
-0.986	Mailer daemon failure notice (2)
-1	X-Mailer header indicates a non-spam MUA (Gnus)
-1	User-Agent header indicates a non-spam MUA(Gnus)
-1	Subject contains newsletter header (in review)
-1	From: looks like US Telephone Number
-1	recommended page from MailBits.com
-1	Talks about tracking numbers
-1	Common footer for MSN
-1	A MailMan confirm-your-address message

SpamAssassin Features

-1.118	Common footer for MSN
-1.128	Contains a password retrieval system
-1.152	Something about registration
-1.176	User-Agent header indicates a non-spam MUA(Mutt)
-1.301	Came from MSN Communities
-1.334	exists:X-Cron-Env
-1.433	Subject looks like order info
-1.451	From the Mailer-Daemon
-1.596	Subject contains a date
-1.628	Contains what looks like an email attribution
-1.696	Common footer for Hotmail
-1.780	X-Mailer header indicates a non-spam MUA (AppleMail)
-1.801	Common footer for Hotmail
-1.898	Sent through Microsoft's ListBuilder service
-2.092	Short signature present (empty lines)
-2.170	Common footer for Hotmail

SpamAssassin Features

-2.174	Message from eBay
-2.442	Contains what looks like a patch from diff -c
-2.473	Looks like a Debian BTS bug
-2.475	Common footer for Hotmail
-2.550	Subject is an eBay question
-2.699	Looks like a Bugzilla bug
-2.863	User-Agent header indicates a non-spam MUA(KMail)
-3.052	non-spam Yahoo! Groups banner found
-3.127	Long signature present (no empty lines)
-4.0	Uses the Habeas warrant mark(http://www.habeas.com/)
-6	User is listed in 'whitelist_to'
-10	Not Matt's Scripts formmail.pl
-10	Bonded sender, seehttp://www.bondedsender.org/referred.html
-20	User is listed in 'more_spam_to'
-100	User is listed in 'all_spam_to'
-100	From: address is in the user's white-list

How to Categorize? (unsupervised)

What if we don't have supervised training data?

Might try an iterative approach as usual:

1. Cluster the messages
2. Train n-gram, Naive Bayes, or decision list model to discriminate among the clusters
3. Use the model to reassign messages to clusters (most will stay put but some will move)
4. Return to step 2 until convergence

How to Categorize? (semisupervised)

What if we have only a little supervised data?

Could try bootstrapping like Yarowsky's WSD:

1. Start with very small, rather accurate classes
2. Train n-gram, Naive Bayes, or decision list model to discriminate among the classes
3. Augment each class with new messages that the model **confidently** classifies there (maybe also move or remove some existing messages)
4. Return to step 2 until convergence

How to Categorize? (adaptive)

What if we gradually get more new data over time?

- User feedback (active or passive) on our classifications
- News / email systems that categorize, or judge relevance
  - Add new articles / messages to training data
  - If they're unlabeled (no supervision), label them automatically
    - Add them only if we're confident? Add them fractionally, like EM?

So model adjusts over time:

- E.g., change the cluster centroids or n-gram parameters
- May want to weight the more recent data more heavily, since the future is more like the present than the past
  - E.g., message from k days ago has weight 0.9^k (k=0,1,2, ...)
  - So today's model = today's data + 0.9 * yesterday's model

How to Categorize? (hierarchical)

What if we are putting document in a Yahoo! category?

- There are thousands of categories (at least) – too hard!
- Choose one of the 14 top-level categories, e.g., Science
- Then use a Science-specific classifier to choose one of the 54 second-level categories within Science (14 are symlinks)
- Continue working your way down the tree ...
- When you can't classify with high confidence, ask a human (then use the human's answer as more training data)