3-1: Introduction to Content-Based Recommenders

Learning Objectives

- To understand the range and value of content-based approaches to recommendation
  - Pure information filtering systems
  - Case-based reasoning systems
  - Knowledge-based navigation systems
- To understand the strengths and drawbacks of content-based recommender systems

Basic Idea: Stable Preferences

- Let's consider some examples:
  - News – I prefer stories on technology, University of Minnesota, Minnesota Vikings, restaurant reviews
  - Clothing – I prefer cotton, blue, low-priced, casual
  - Movies – I prefer Tom Hanks, Sandra Bullock, Woody Allen, Comedy
  - Hotels – I prefer 24-hour front desk, room service, internet, pool

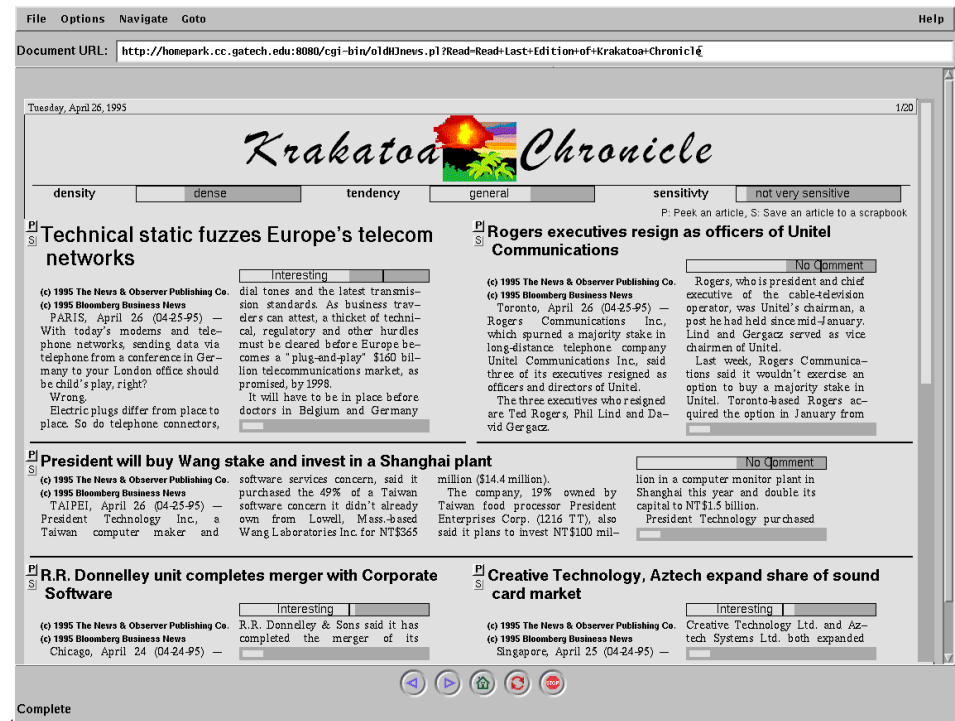# The key ideas

- Model items according to relevant attributes
- Model or reveal user preferences by attribute
- Voila! A Recommender

Content-Based Filtering

- Key concept: building a vector of attribute or keyword preferences
- Example: Krakatoa Chronicle

  http://www.w3.org/Conferences/WWW4/Papers/93

  Kamba, Bharat, and Albers (WWW '95)
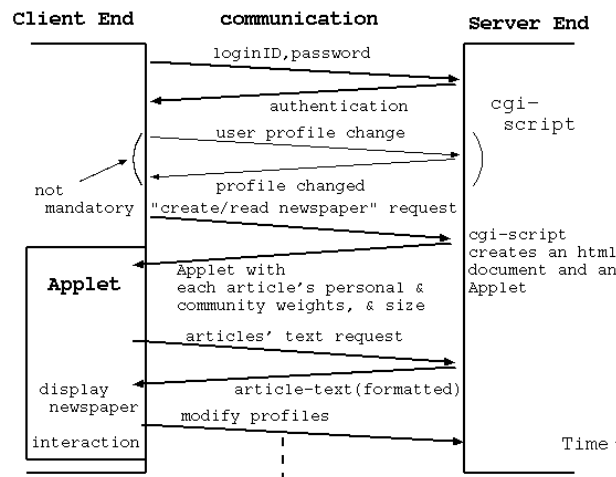
Wide range of Possibilities

- User could build own profile (awkward)
  - But allowing user to edit a profile can be valuable
- Infer profile from user actions
  - Read, Buy, Click
- Infer profile from explicit user ratings
  - How to map from item preference to attribute preference
- We merge actions/explicit into infer from ratings (explicit and implicit)

How to build preferences?

- Let's start with the idea of a set of "keywords" that users may like, dislike, or not have an opinion on
- We could simply count the number of times the user chooses (or fails to choose) items with each keyword
- Or we can get more sophisticated
- More to come (future lecture) …

How to use preferences

- Given a vector of keyword preferences
  - Do we just add up likes and dislikes?
  - Can we figure out which keywords are more and less relevant?
- Forward reference: TFIDF

Content-Based Recommenders

- Our assignments will be based on this model
  - Hand exercises: building a profile and using it to predict a few cases
  - Programming exercise: building a content-based recommender

- But first, a few other approaches …

Case-Based Recommendation

- The concept:
- Structure a database of cases around a set of relevant attributes (e.g., camera price, zoom, pixels)
- Query based on an example or attribute query, and retrieve relevant cases
- Open issue: Many ways to structure interaction

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- No longer exists (old screenshots)
- Uses an interview process to elicit preferences over attributes
- Uses preferences to recommend products
- Uses recommendation as a point to elicit further preferences
- Note: not intended as permanent preferences – just transactional
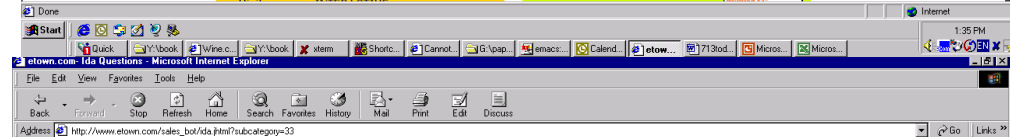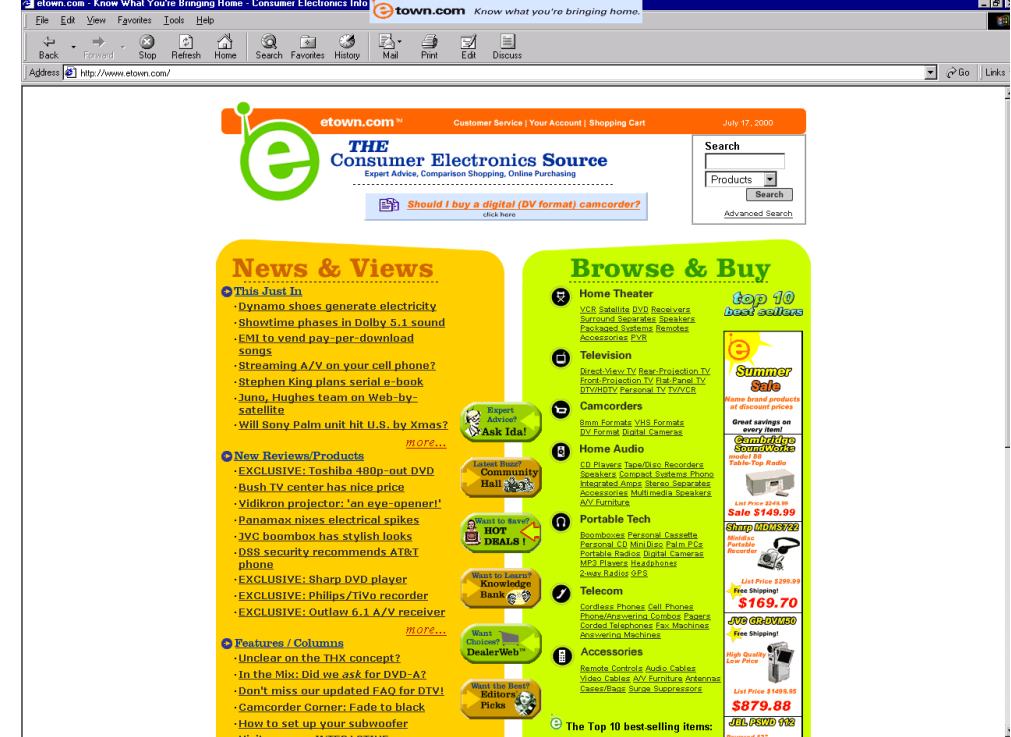
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Experience

Your answers to the next 2 questions will help me determine which digital cameras I should recommend to you.

In general, how experienced a photographer are you?

- I'm a casual user. I like to shoot pictures, and I don't like to fuss with technology. The simpler my camera is, the better I like it.
- I know my way around a camera. I'm interested in a digital camera with features that can make my work better and more enjoyable.
- I'm an avid photographer. I want an advanced digital camera that can keep up with my ideas and provide me with the most creative options.

Next question →

High-end features

All digital cameras are capable of point-and-shoot simplicity, but some have more options and features than others. If you're a casual photographer, many of these features can appear intrusive, and in most shooting situations, you may not ever need them. However, if you're an experienced photographer, you'll want a model with an extensive feature set that includes manual overrides, so that you'll have control over exposure and focus for creative effects.

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[The worlds largest Selection] netflix.com

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Budget choice

I have divided all the digital cameras into 4 budget categories. If you would like, I can exclude products that cost more than you are willing to spend.

About how much would you consider spending on a new digital camera?

- Up to $300. In this price range you can expect to find a fairly basic digital camera with no zoom lens and standard picture resolution (under a megapixel). These cameras will produce images that are fine for posting to the Web or emailing, but do less well when they're printed on paper. All of the 6 digital cameras in this range fit your expressed needs well.
- Up to $600. At the lower end of this price range you'll find some megapixel cameras that produce images that can be printed out at small sizes with acceptable results. Toward the high end, there are feature-rich cameras that produce fairly high-quality images that translate into sharp prints at sizes up to 4 x 6 inches. All of the 24 digital cameras in this range fit your expressed needs well.
- Up to $900. If bigger-sized hard copies are what you're after, you'll probably have to step up to this price range. Cameras here generally have a zoom lens and a minimum resolution of 1.3 megapixels; some top the 2-megapixel mark. Most models in this category also have more flexibility in their operation, with more manual settings. All of the 46 digital cameras in this range fit your expressed needs well.
- $1000 or more. This is "prosumer" territory -- the fine line between professional and consumer gear. Many models have 2-megapixel or better resolution, as well as plenty of manual options for more advanced users. Zoom is standard, and some models may have options for adding lenses (wide angle or telephoto). All of the 50 digital cameras in this range fit your expressed needs well.

See initial recommendations ✓

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Initial recommendations

Here's my initial suggested shortlist of the products that best meet your needs, based on what you've told me so far. They all offer an LCD view screen, manual overrides, an optical viewfinder, a serial output connection, a video out connection, a built-in digital zoom, and are within your requested price range.

Olympus D450Z See etown.com Review $499
Pros: It can store 18 pictures at its highest resolution, it has 1280 × 960 pixels resolution, it uses SmartMedia to store pictures, and it has an optical zoom lens.

Olympus D460 Zoom Buy $499
Pros: It can store 18 pictures at its highest resolution, it has 1280 × 960 pixels resolution, it uses SmartMedia to store pictures, and it has an optical zoom lens.

Fuji MX1200 See etown.com Review Buy $299
Pros: It can store 23 pictures at its highest resolution, it has 1280 × 960 pixels resolution, and it uses SmartMedia to store pictures. Cons: it doesn't have an optical zoom lens.

Nikon 800 Buy $599
Pros: It has 1600 × 1200 pixels resolution, it has CompactFlash storage media, and it has an optical zoom lens. Cons: it can store only 8 pictures at its highest resolution.

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I can refine these recommendations if you tell me more about your needs. I suggest **Optical zoom** as the next question to consider, or you can select the topic you wish:

Next question [Optical zoom ▼] →

I can also show you a feature-by-feature comparison of any of the digital cameras listed on this page.

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Other suitable products

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Optical zoom

Not every digital camera has the ability to zoom in for closeups. Some can, but only by digitally enlarging what the lens sees, a technique which is not as effective as an optical zoom. Some models have an actual optical zoom lens.

How important is a zoom?

- Not very. I'm not shooting from any great distances, I don't need to spend extra on a zoom feature.
- A digital zoom is fine. I don't need anything too extensive, but some kind of zoom feature would be useful to me.
- I need an optical zoom. I need a the best possible zoom function on my digital camera.

See Recommendations ✓

Optical and digital zoom

A zoom lens brings the subject you're shooting closer -- a useful feature if you're at a distance from your subject. However, there's a big difference between a digital and optical zoom.

A digital zoom doesn't really zoom at all. What it does is electronically enlarge the information that the lens is seeing. While this does make the image larger (more close up), the image quality suffers from the digital manipulation.

An optical zoom is part of the lens itself -- there's no digital sleight-of-hand, and no degradation of the image, no matter how much you zoom. Because an optical zoom is hardware, as opposed to a digital zoom, which is done in software, a digital camera with an optical zoom is usually more costly.

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✓ **Recommendations**
Here's my shortlist of the products that best meet your needs, based on the new information you gave me. They all offer an LCD view screen, manual overrides, an optical viewfinder, a built-in digital zoom, an optical zoom lens, and are within your requested price range.

Olympus D450Z See etown.com Review $499
Pros: it can store 18 pictures at its highest resolution, it has 1280 x 960 pixels resolution, it uses SmartMedia to store pictures, and it has a video out connection.

Olympus D460 Zoom Buy $499
Pros: it can store 18 pictures at its highest resolution, it has 1280 x 960 pixels resolution, it uses SmartMedia to store pictures, and it has a video out connection.

Fuji FinePix1400 Buy $399
Pros: it has 1280 x 960 pixels resolution, it uses SmartMedia to store pictures, and it has a USB connection. Cons: it can store only 6 pictures at its highest resolution, it doesn't have a serial output connection, and it doesn't have a video out connection.

Nikon 800 Buy $599
Pros: it has 1600 x 1200 pixels resolution, it has CompactFlash storage media, and it has a video out connection. Cons: it can store only 8 pictures at its highest resolution.

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I can refine these recommendations if you tell me more about your needs. I suggest **Shooting aids** as the next question to consider, or you can select the topic you wish:

Next question [Shooting aids] →

I can also show you a feature-by-feature comparison of any of the digital cameras listed on this page.

Compare Products ✓

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✓ **Nikon 800 - $599.00 (msrp)**
Given the information you have provided, the Nikon 800 is one of my top recommendations. Click the link to go directly to a question that will explain the feature and help you decide if that feature makes sense for you!

Pros: Its advantages include:
- it has an LCD view screen.
- it has manual overrides.
- it has an optical viewfinder.
- it has 1600 x 1200 pixels resolution.
- it has a serial output connection.
- it has CompactFlash storage media.
- it has a video out connection.
- it has a built-in digital zoom.
- it has an optical zoom lens.

Cons: Possible disadvantages include:
- it can store only 8 pictures at its highest resolution.
- it doesn't have a USB connection.

*The Nikon 800 is available for online purchase.

Return to Recommendations ✓
Show full specification ✓
Next Question →

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Modify Comparison List | Return to Product List

Your Product Comparisons

Products are compared by key features. When a product lacks a feature, the feature appears in pale grey. To view a full Product Profile, click on the corresponding model number. To compare different products, click on Modify Comparison List (above).

Digital Cameras:	Digital Cameras:	Digital Cameras:
Fuji	Nikon	Olympus
Model No: FinePix1400	Model No: 800	Model No: D450Z
1.2-megapixel digital camera	CoolPix 2.1-megapixel digital camera	1.2-megapixel digital camera
1 year parts & labor	1 year parts & labor	1 year parts & labor
List Price: $399.00	List Price: $599.00	List Price: $499.00
Low Price: $329.00	Low Price: $489.99	--- --- ---
High Price: $329.00	High Price: $498.00	--- --- ---
$ Buy Now!	$ Buy Now!	Find Local Retailer
Find Local Retailer	Find Local Retailer	
320 x 240	320 x 240	320 x 240
640 x 400	640 x 400	640 x 400
800 x 600	800 x 600	800 x 600
1024 x 760	1024 x 760	1024 x 760
1200 x 1024	1200 x 1024	1200 x 1024
1536 x 1024	1536 x 1024	1536 x 1024
1344 x 1000	1344 x 1000	1344 x 1000

1760 x 1160	1760 x 1160	1760 x 1160
1152 x 064	1152 x 064	1152 x 064
1280 x 960	1200 x 960	1280 x 960
1600 x 1200	1600 x 1200	1600 x 1200
1000 x 1200	1000 x 1200	1000 x 1200
6 pictures at highest resolution	8 pictures at highest resolution	18 pictures at highest resolution
40 pictures at lowest resolution	50 pictures at lowest resolution	122 pictures at lowest resolution
Built-in flash	Built-in flash	Built-in flash
Compact body	Compact body	Compact body
Digital zoom	Digital zoom	Digital zoom
Floppy disk storage	Floppy disk storage	Floppy disk storage
IEEE-1394 output	IEEE-1394 output	IEEE-1394 output
LCD view screen	LCD view screen	LCD view screen
Megapixel resolution	Megapixel resolution	Megapixel resolution
SLR-type body	SLR-type body	SLR-type body
Optical zoom lens	Optical zoom lens	Optical zoom lens
Optical viewfinder	Optical viewfinder	Optical viewfinder
Manual overrides	Manual overrides	Manual overrides
Serial output	Serial output	Serial output
Storage media: CompactFlash	Storage media: CompactFlash	Storage media: CompactFlash
Storage media: SmartMedia	Storage media: SmartMedia	Storage media: SmartMedia
Storage media: Memory Stick	Storage media: Memory Stick	Storage media: Memory Stick
USB output	USB output	USB output
Video output	Video output	Video output
Windows software included	Windows software included	Windows software included
Macintosh software included	Macintosh software included	Macintosh software included

Knowledge-Based Recommender

- Case-Based Example with Navigation Interface
- FindMe Systems (e.g., Entrée)

Figure 3: Navigation using the "Less $$" tweak

More Generally

- Case-Based Approaches (Knowledge, Database, etc.) are often most helpful for ephemerally-personalized experiences
  - Shopping – suggest similar relevant items
    - Compare with collaborative – suggest items that are co-purchased or co-browsed
  - Content – suggest similar stories
- Case-Based recommendations are often easier to explain to the user

Challenges and Drawbacks

- Content-Based Techniques in general …
  – Depend on well-structured attributes that align with preferences (consider paintings)
  – Depend on having a reasonable distribution of attributes across items (and vice versa)
  – Unlikely to find surprising connections (e.g., chili peppers or lemon with chocolate)
  – Harder to find complements than substitutes

Some take-away lessons

- Many ways to recommend based on content (product attributes)
  – Long-term: build profile of content preferences
  – Shorter-term: build database of cases; navigate
- Content-based techniques work without a large set of users (but need item data)
- Good at finding substitutes; good at helping navigate for a purchase; good explainability

Moving Forward

- Next Lectures
  – For programmers: Introduction to LensKit
  – For everyone: deeper dive into content profiles, content retrieval and filtering
- Later this Module
  – Programming deep dive; guest lectures on case-based and knowledge-based; survey of tools for content recommending

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