

Measuring user happiness

- Issue: Who is the user we are trying to make happy?
 - It depends.



Measuring **stakeholder** happiness

- Issue: Who is the user we are trying to make happy?
- Web engine:
 - The user finds what they want.
 - Measure whether or not they come back.



Measuring **stakeholder** happiness

- Issue: Who is the user we are trying to make happy?
 - eCommerce Site
 - User finds what they want
 - Are we interested in the happiness of the site?
 - Are we interested in the happiness of the customer?
 - Measure the \$\$ of sales per user
 - Measure number of transactions per user
 - Measure time to purchase
 - Measure conversion rate (lookers -> buyers)



Measuring **stakeholder** happiness

- Issue: Who is the user we are trying to make happy?
- Enterprise site
 - Are the users “productive”?
 - Measure time savings when using site
 - Measure “things accomplished”
 - careful about confounding factors
 - Measure how much a user utilizes the site’s features



Measuring **stakeholder** happiness



Measuring **stakeholder** happiness

- Can we measure happiness?



Measuring **stakeholder** happiness

- Can we measure happiness?
- Do we want to measure happiness?



Measuring **stakeholder** happiness

- Can we measure happiness?
- Do we want to measure happiness?
- What are some proxies for happiness?



Measuring **stakeholder** happiness

- Can we measure happiness?
- Do we want to measure happiness?
- What are some proxies for happiness?
 - Relevance of search results



Measuring **stakeholder** happiness

- Can we measure happiness?
- Do we want to measure happiness?
- What are some proxies for happiness?
 - Relevance of search results
 - How do we measure relevance?



Measuring Relevance Instead

- What do we need to measure relevance?
 - A document collection, a **test corpus**
 - A set of queries, **benchmark queries**
 - A set of answers, **a gold standard**
 - i.e., Document, d , {is, is not} relevant to query q
 - Alternatives to binary exist, but atypical
- Cross-validation methodology
 - Parameter tuning



Information need

- Remember the user has an **information need**
 - not a query
- Relevance is assessed in relation to the information need, not the query
 - e.g., I am looking for information on whether drinking red wine is more effective than eating chocolate at reducing risk of heart attacks
 - Query: red wine heart attack effective chocolate risk
 - Does the document address the **need**, not the query



Relevance benchmarks

- TREC - National Institute of Standards and Testing (NIST) has run a large IR test bed for many years
- Reuters and other benchmark document collections
- Retrieval tasks which are specified
 - sometimes as queries
- Human experts mark, for each query and for each document
 - Relevant or Irrelevant



Unranked retrieval

- Precision:
 - Fraction of retrieved documents that are relevant
- Recall:
 - Fraction of relevant documents that are retrieved



Unranked retrieval

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 - Fraction of retrieved documents that are relevant
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	<i>Relevant</i>	<i>Not Relevant</i>
<i>Retrieved</i>	<i>TP</i>	<i>FP</i>
<i>Not Retrieved</i>	<i>FN</i>	<i>TN</i>



Unranked retrieval

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$$? \text{ Precision} = \frac{TP}{TP + FP}$$

?



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$$? \text{ Precision} = \frac{TP}{TP + FP}$$

$$? \text{ Recall} = \frac{TP}{TP + FN}$$



Unranked retrieval - Accuracy

- The difficulty with measuring “accuracy”
- In one sense accuracy is how many judgments you make correctly

$$\textit{Accuracy} = \frac{TP + TN}{TP + FP + FN + TN}$$

	<i>Relevant</i>	<i>Not Relevant</i>
<i>Retrieved</i>	<i>TP</i>	<i>FP</i>
<i>Not Retrieved</i>	<i>FN</i>	<i>TN</i>

- Why is this not a very useful measure?
- 

Exercise

- Documents A - F, Query q

<i>Document</i>	<i>Relevant(q)</i>	<i>Not Relevant(q)</i>
<i>A</i>	✓	
<i>B</i>		✓
<i>C</i>		✓
<i>D</i>	✓	
<i>E</i>		✓
<i>F</i>	✓	

- If my system returns A,C,D,E to query q....
 - How many TP, TN, FP, FN do I have?

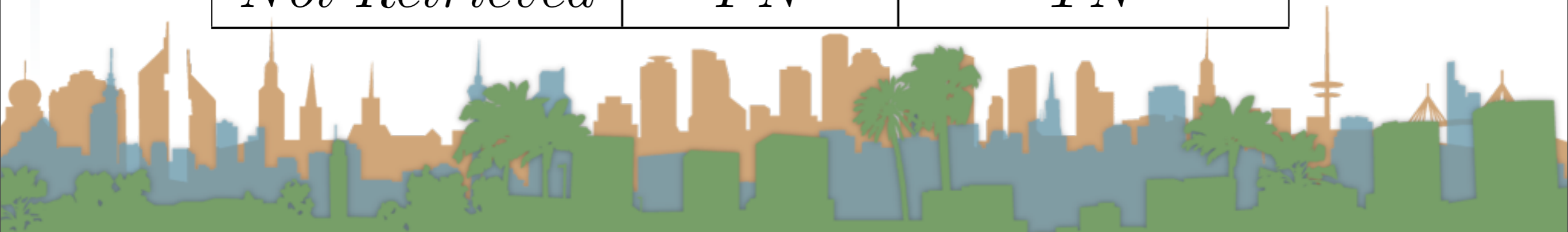


Exercise

Retrieved : A C D E

<i>Document</i>	<i>Relevant(q)</i>	<i>Not Relevant(q)</i>
<i>A</i>	✓	
<i>B</i>		✓
<i>C</i>		✓
<i>D</i>	✓	
<i>E</i>		✓
<i>F</i>	✓	

	<i>Relevant</i>	<i>Not Relevant</i>
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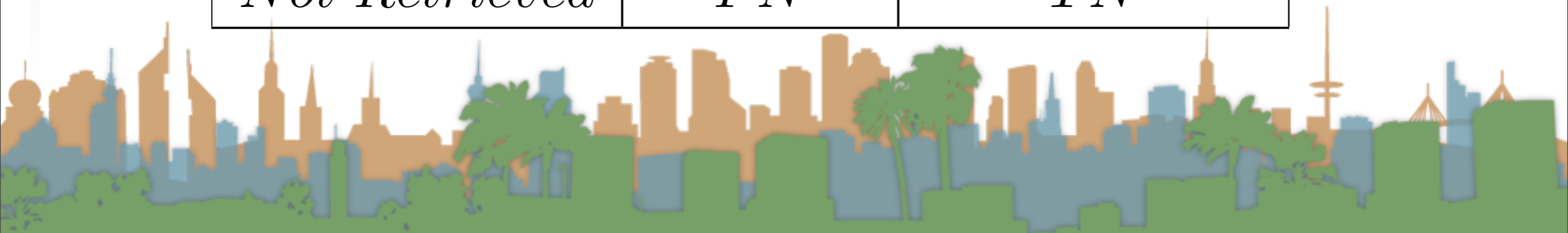


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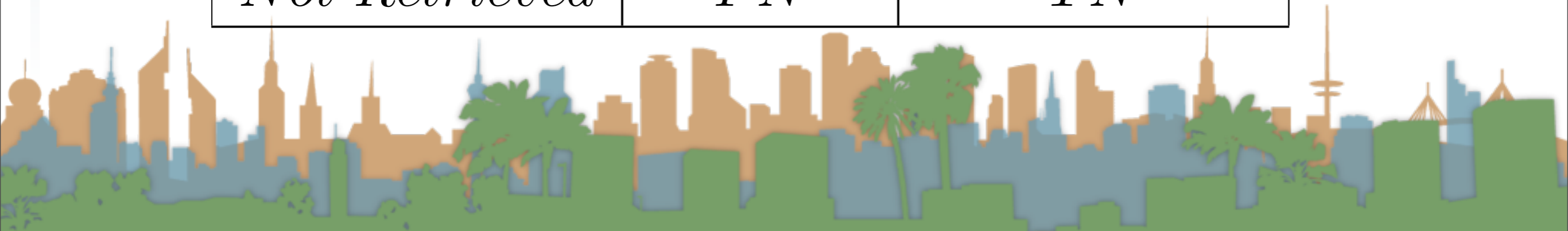


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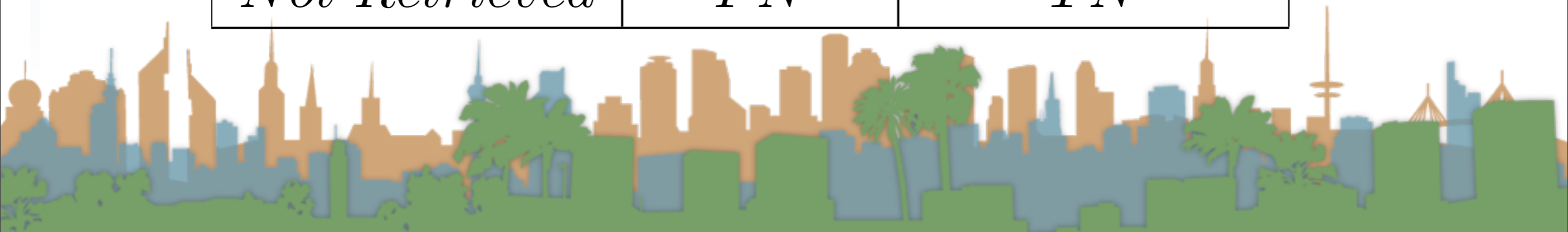


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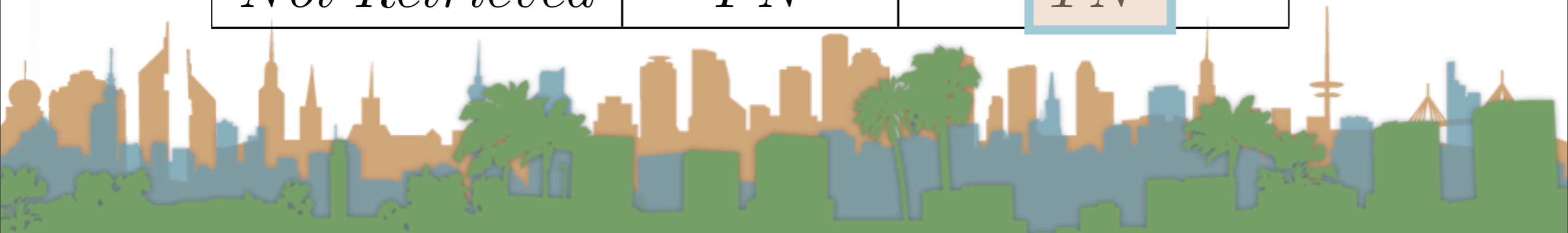


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Exercise

- What is our precision?

TP	2
FP	2
FN	1
TN	1

- What is our recall?

- What is our accuracy?



Exercise

- What is our precision?

$$Precision = \frac{TP}{TP + FP}$$

<i>TP</i>	2
<i>FP</i>	2
<i>FN</i>	1
<i>TN</i>	1

- What is our recall?

- What is our accuracy?



Exercise

- What is our precision?

$$\textit{Precision} = \frac{TP}{TP + FP}$$

<i>TP</i>	2
<i>FP</i>	2
<i>FN</i>	1
<i>TN</i>	1

- What is our recall?

$$\textit{Recall} = \frac{TP}{TP + FN}$$

- What is our accuracy?



Exercise

- What is our precision?

$$\textit{Precision} = \frac{TP}{TP + FP}$$

<i>TP</i>	2
<i>FP</i>	2
<i>FN</i>	1
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- What is our recall?

$$\textit{Recall} = \frac{TP}{TP + FN}$$

- What is our accuracy?

$$\textit{Accuracy} = \frac{TP + TN}{TP + FP + FN + TN}$$



Exercise

- If my system returns A,C,D,E to query q....

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Precision

$\frac{1}{2}$

Recall

$\frac{2}{3}$

Accuracy

$\frac{1}{2}$

- What do I want Precision to be?



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Accuracy

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<i>Precision</i>	$\frac{1}{2}$
<i>Recall</i>	$\frac{2}{3}$
<i>Accuracy</i>	$\frac{1}{2}$

- What do I want Recall to be?



Exercise

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<i>Precision</i>	$\frac{1}{2}$
<i>Recall</i>	$\frac{2}{3}$
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- What do I want Recall to be?

	<i>Relevant</i>	<i>Not Relevant</i>
<i>Retrieved</i>	<i>TP</i>	<i>FP</i>
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$$Recall = \frac{TP}{TP + FN}$$



Exercise

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Precision

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Accuracy

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- What do I want Accuracy to be?



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Precision

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Recall

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Accuracy

$\frac{1}{2}$

- What do I want Accuracy to be?

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<i>Retrieved</i>	<i>TP</i>	<i>FP</i>
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$$Accuracy = \frac{TP + TN}{TP + FP + FN + TN}$$



Unranked retrieval - Accuracy



Unranked retrieval - Accuracy

- Welcome to my search engine



Unranked retrieval - Accuracy

- Welcome to my search engine
- I guarantee a 99.9999% accuracy.



Unranked retrieval - Accuracy

- Welcome to my search engine
 - I guarantee a 99.9999% accuracy.
 - Bring on the venture capital



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Beta

PITTERPATTERSONFINDER

Search for:



Unranked retrieval - Accuracy

- Welcome to my search engine
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- Bring on the venture capital

Beta

PITTERPATTERSONFINDER

Search for:

0 matching results found



Unranked retrieval - Accuracy

$$\textit{Accuracy} = \frac{TP + TN}{TP + FP + FN + TN}$$

$$\textit{Accuracy} = \frac{0 + \uparrow}{0 + 0 + \epsilon + \uparrow}$$



Unranked retrieval - Accuracy

- Most people **want to find something** and can tolerate some junk

$$Accuracy = \frac{TP + TN}{TP + FP + FN + TN}$$

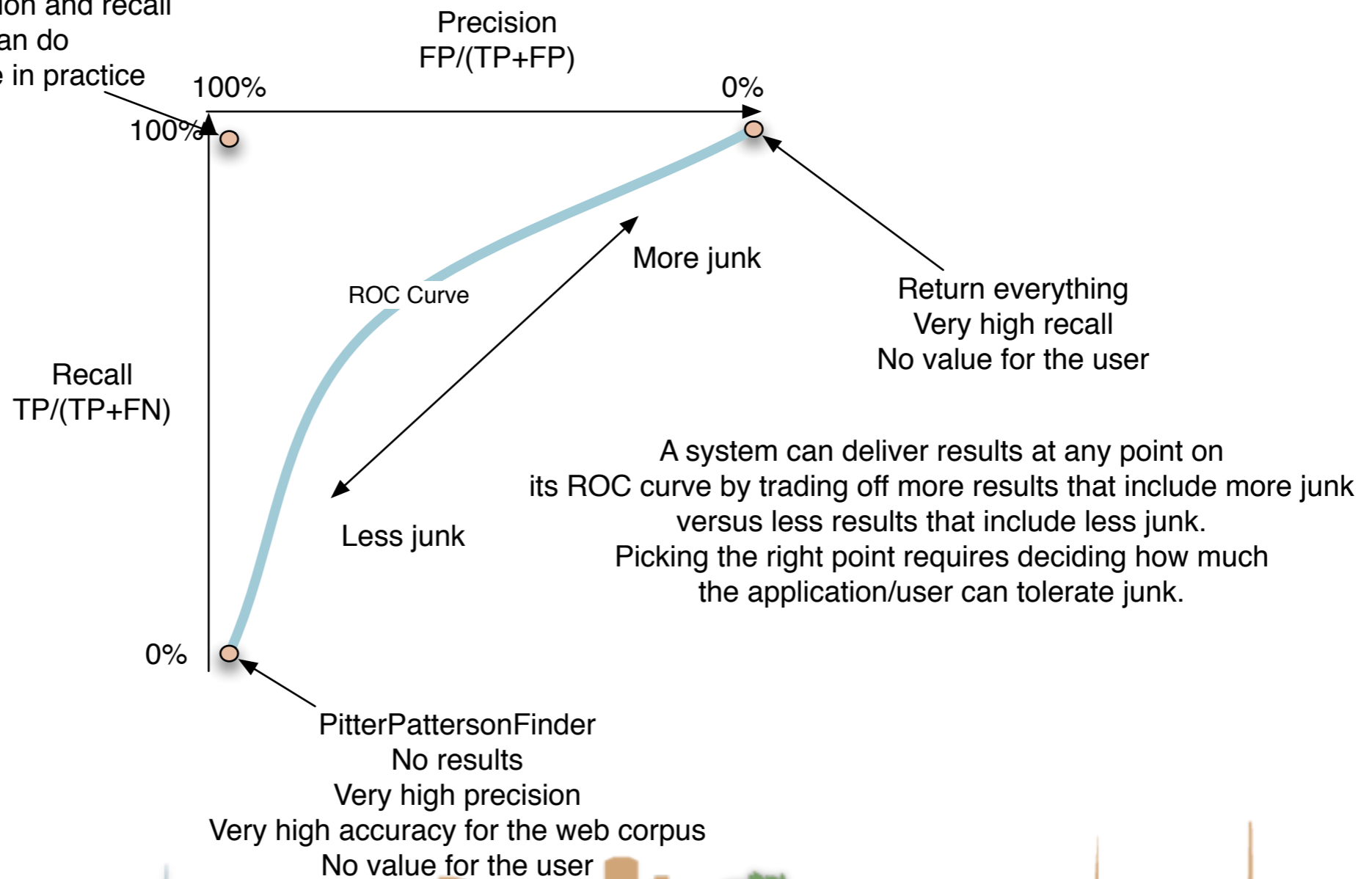
$$Accuracy = \frac{0 + \uparrow}{0 + 0 + \epsilon + \uparrow}$$



Unranked retrieval - ROC curve

Receiver Operating Characteristic (ROC) curve

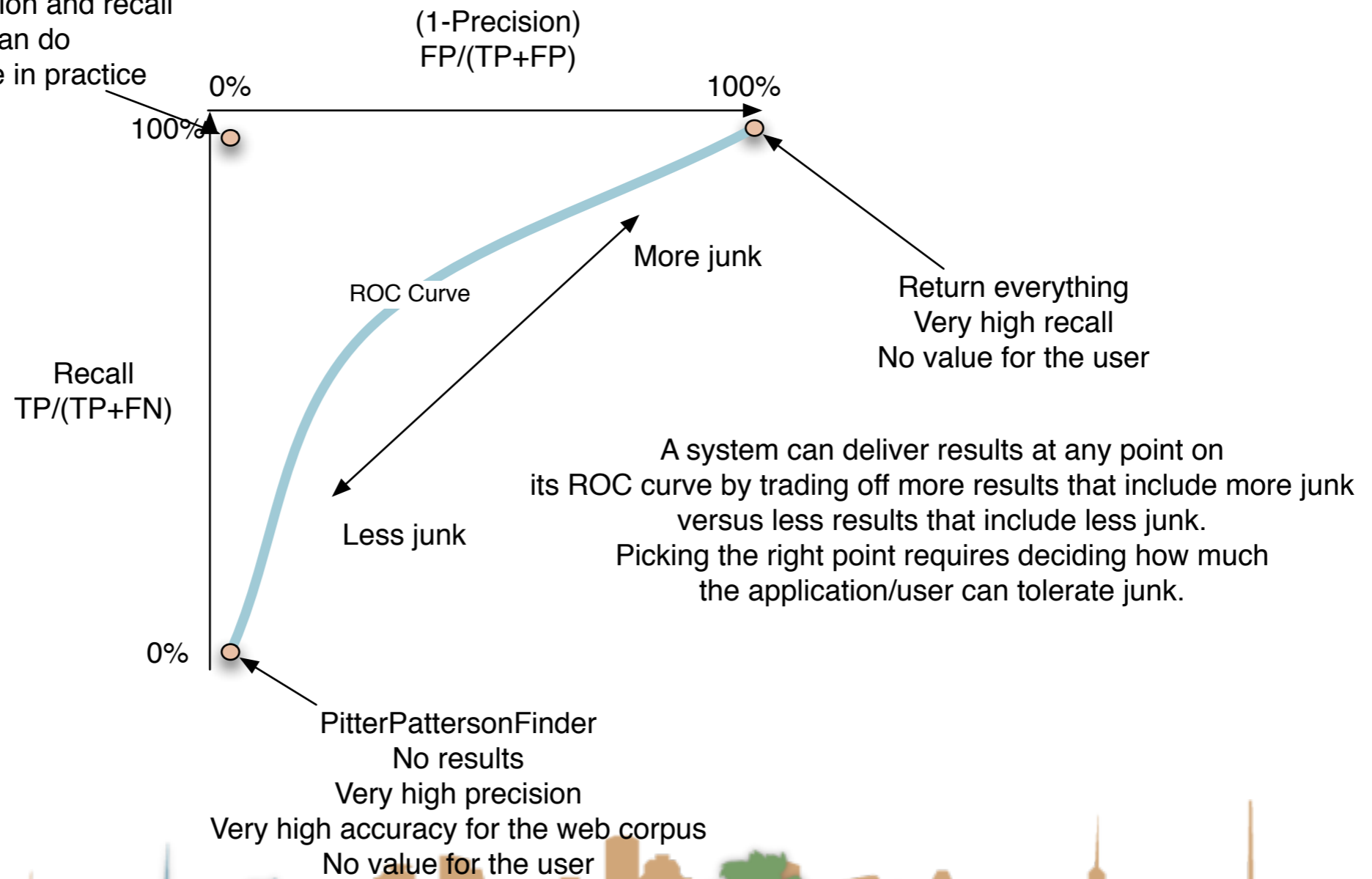
Really good precision and recall
Best you can do
Likely impossible in practice



Unranked retrieval - ROC curve

Receiver Operating Characteristic (ROC) curve

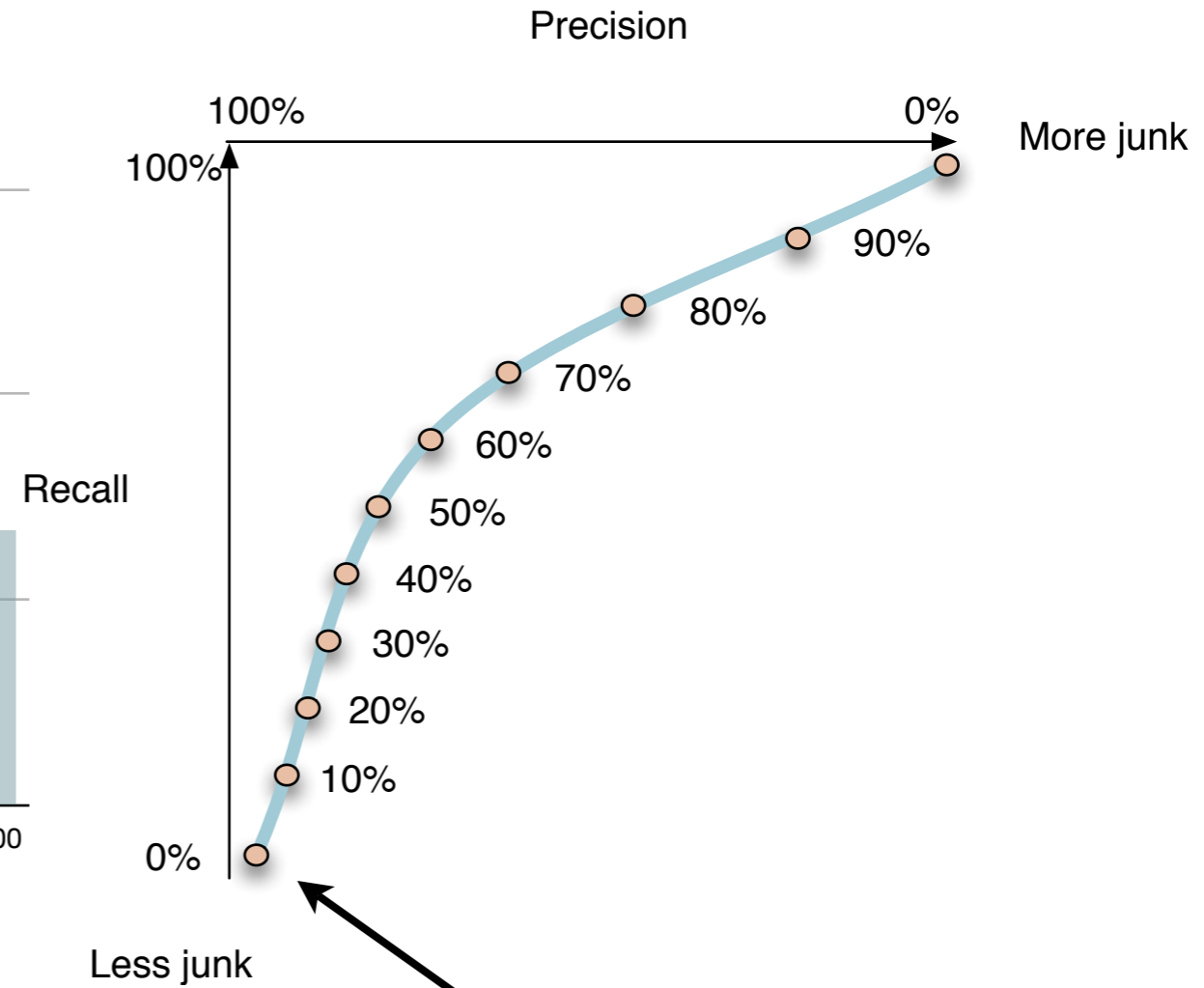
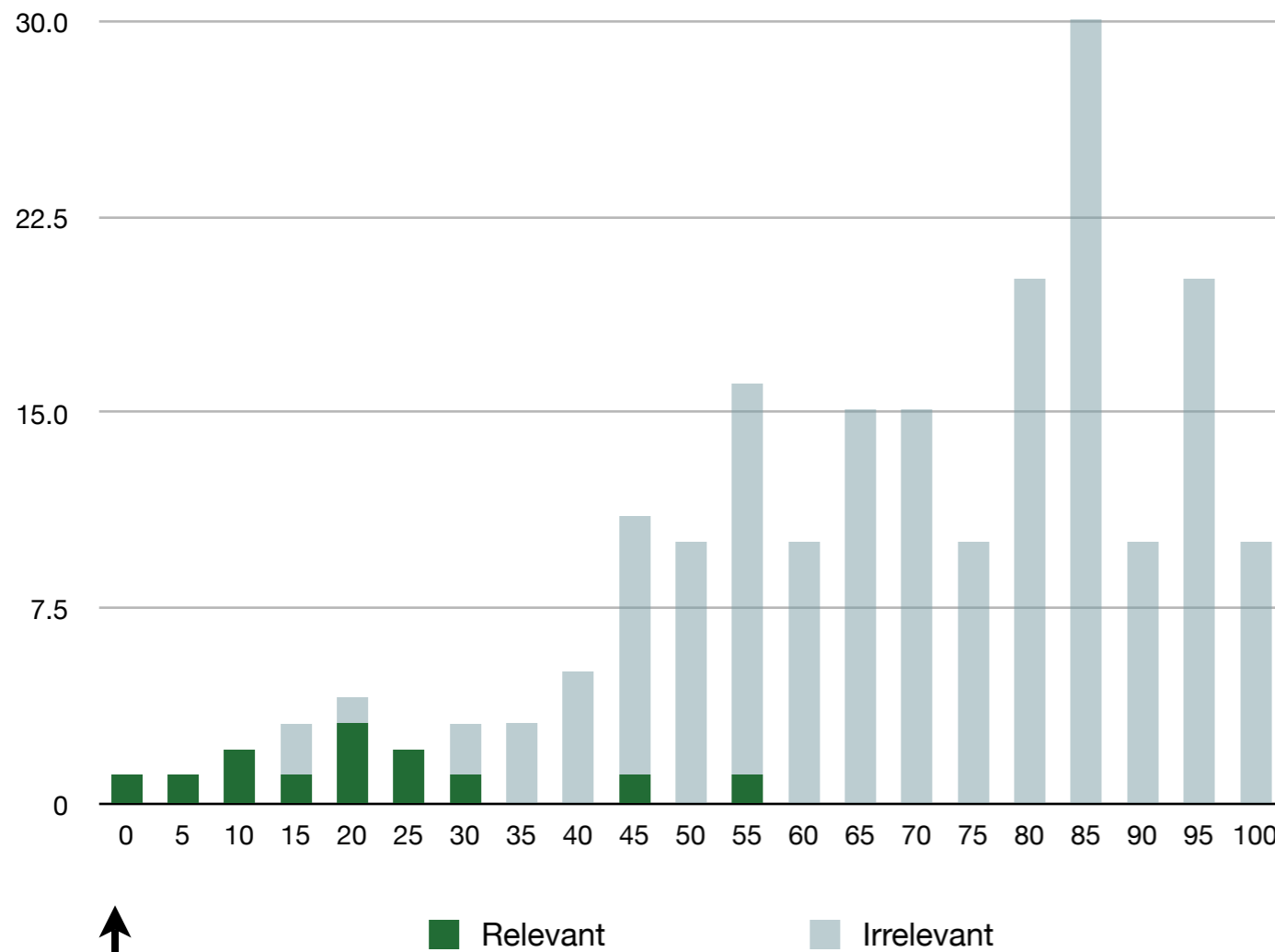
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Unranked retrieval - ROC curve

Receiver Operating Characteristic (ROC) curve

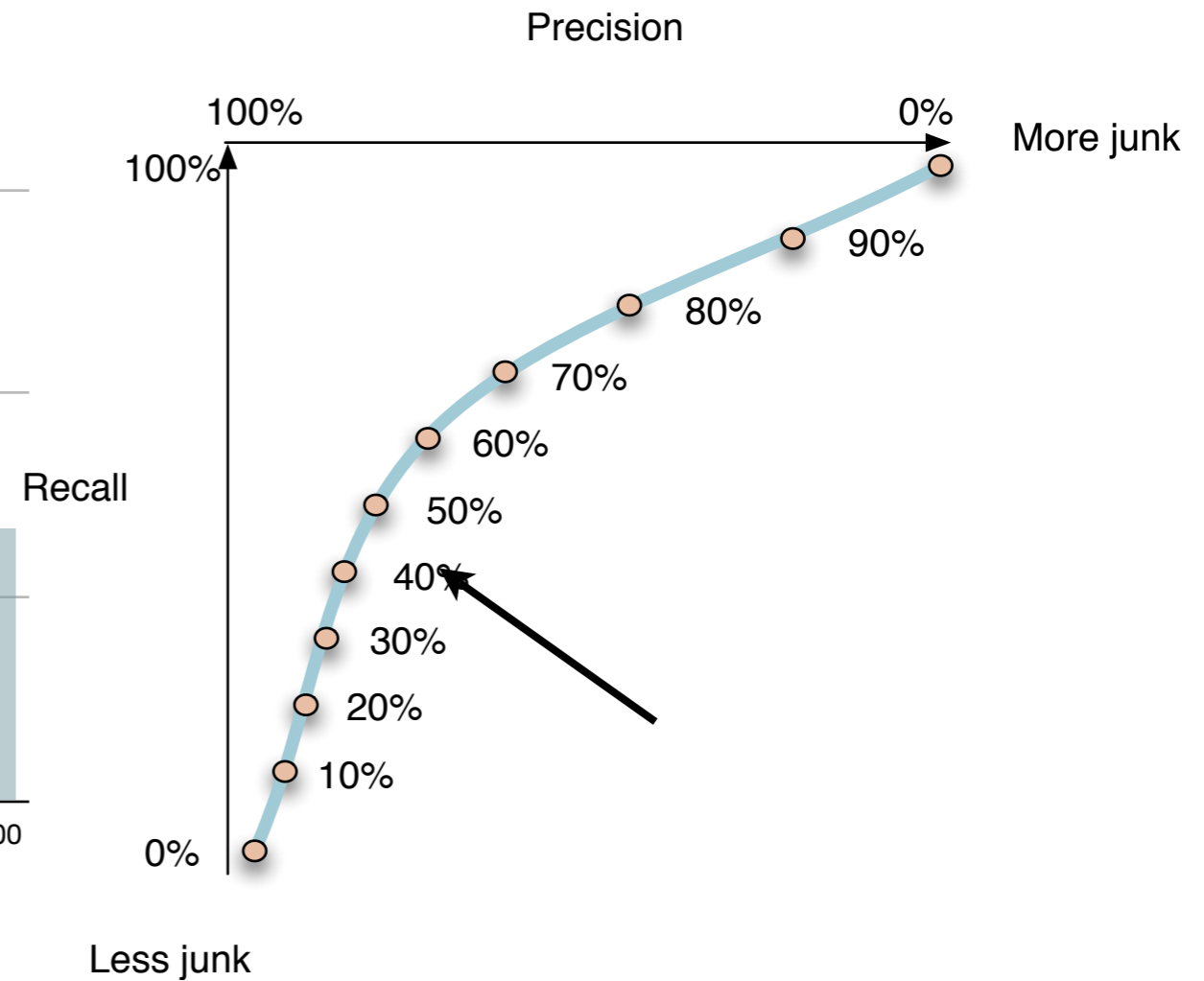
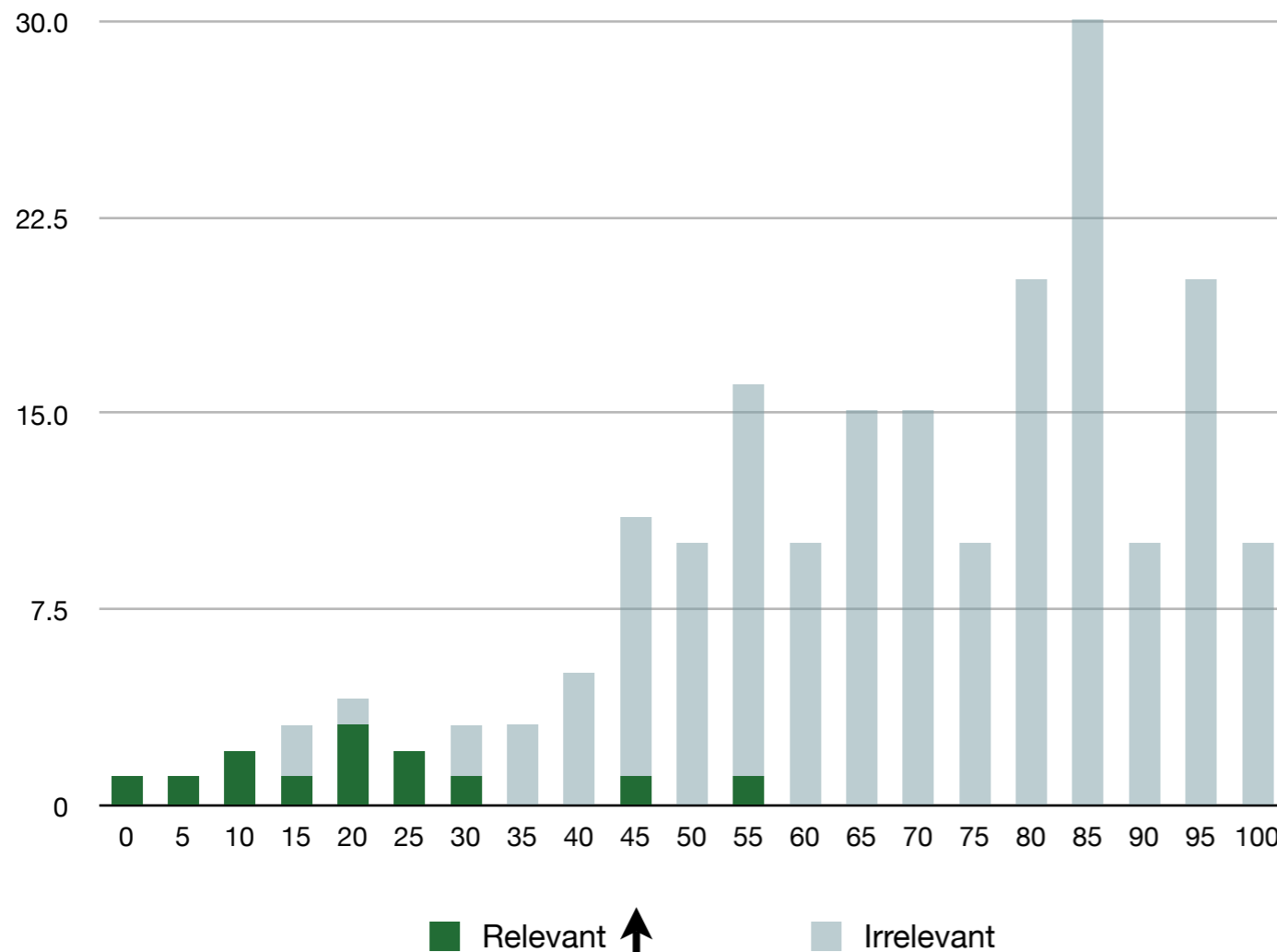
Example Histogram of Documents versus relevance score



Unranked retrieval - ROC curve

Receiver Operating Characteristic (ROC) curve

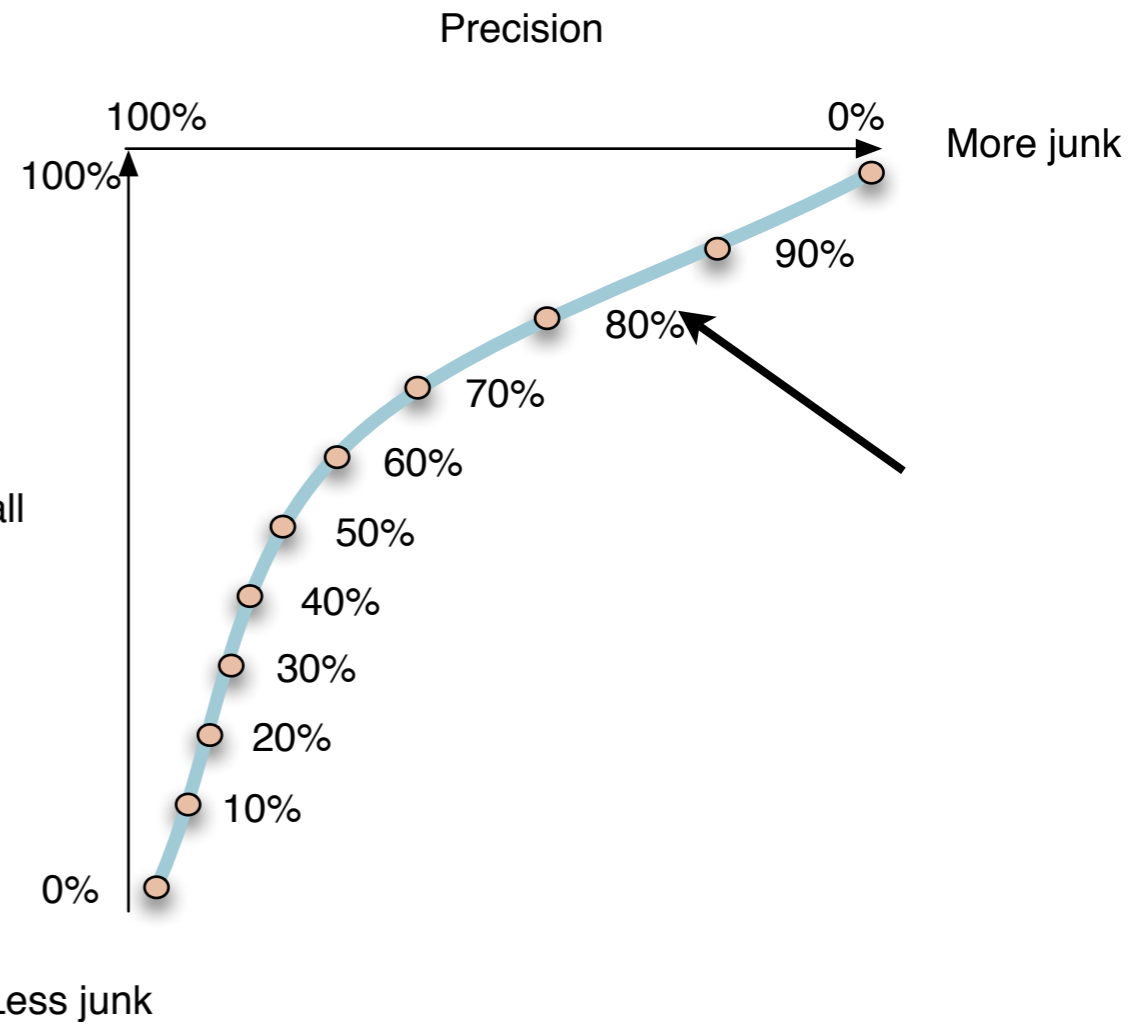
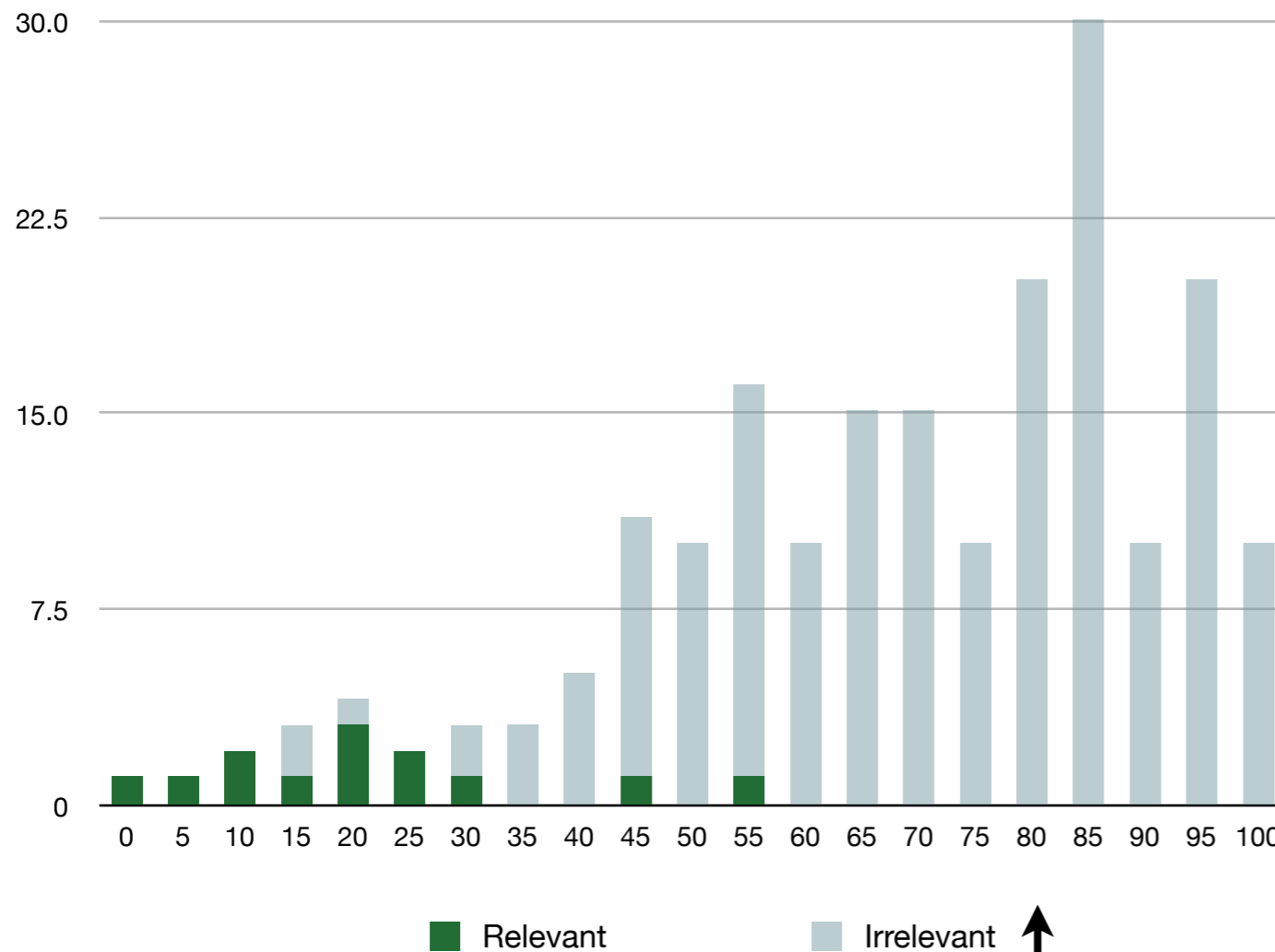
Example Histogram of Documents versus relevance score



Unranked retrieval - ROC curve

Receiver Operating Characteristic (ROC) curve

Example Histogram of Documents versus relevance score



Ranked Retrieval

- Precision and Recall are **set-based measures**
 - They are computed independent of order
 - But, web search return things in lists
 - Lists have order.
 - A better metric of user happiness/relevance is warranted



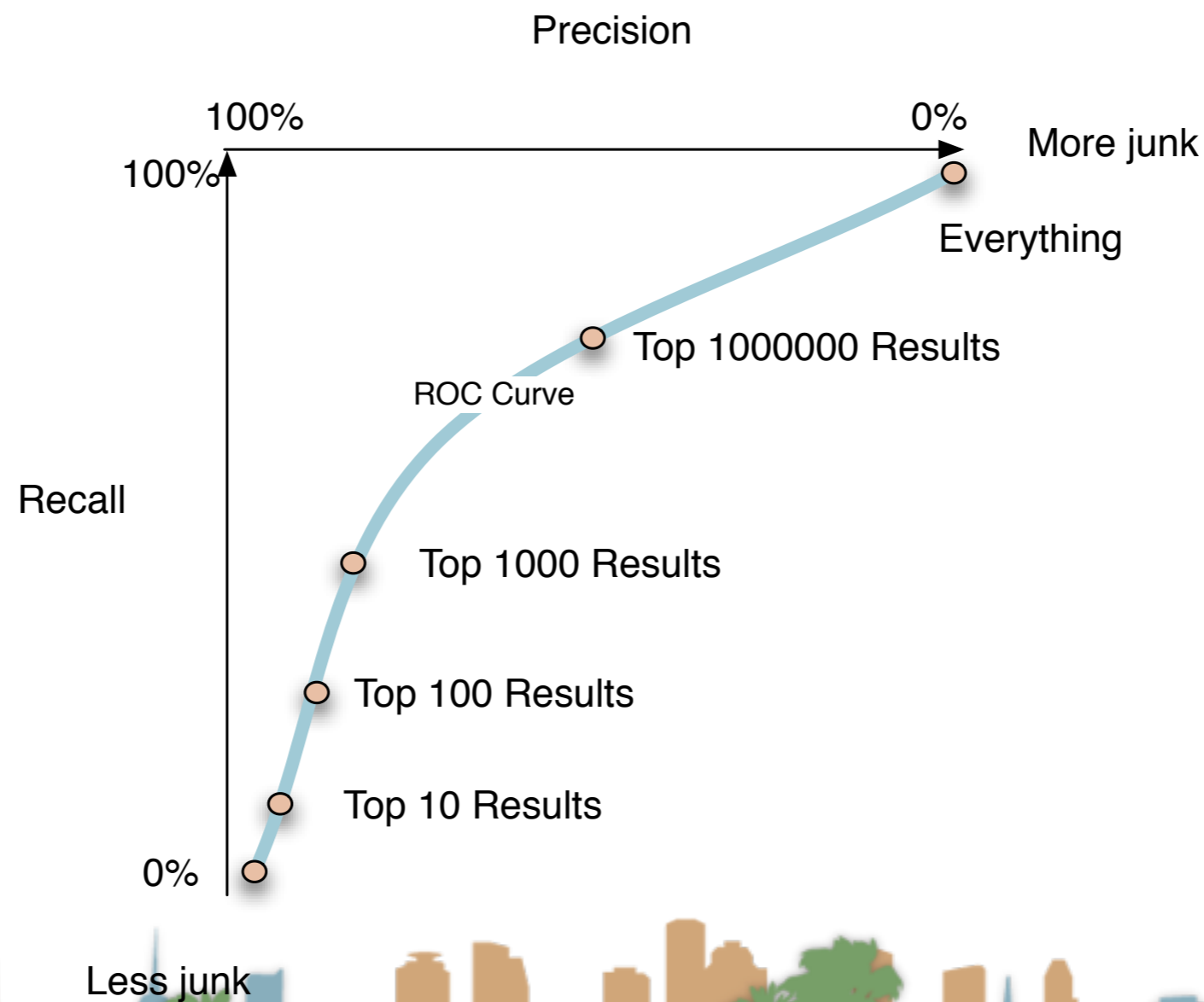
Ranked Retrieval

- Let's use our existing metrics and extend them to ranked retrieval
- In one system we can get many **samples**
- We can get the top X results:
 - $X = 10, 20, 30, 40, \text{ etc...}$
- Each one of those **sets** has a precision and recall value
- Each of those sets corresponds to a point on the ROC curve.



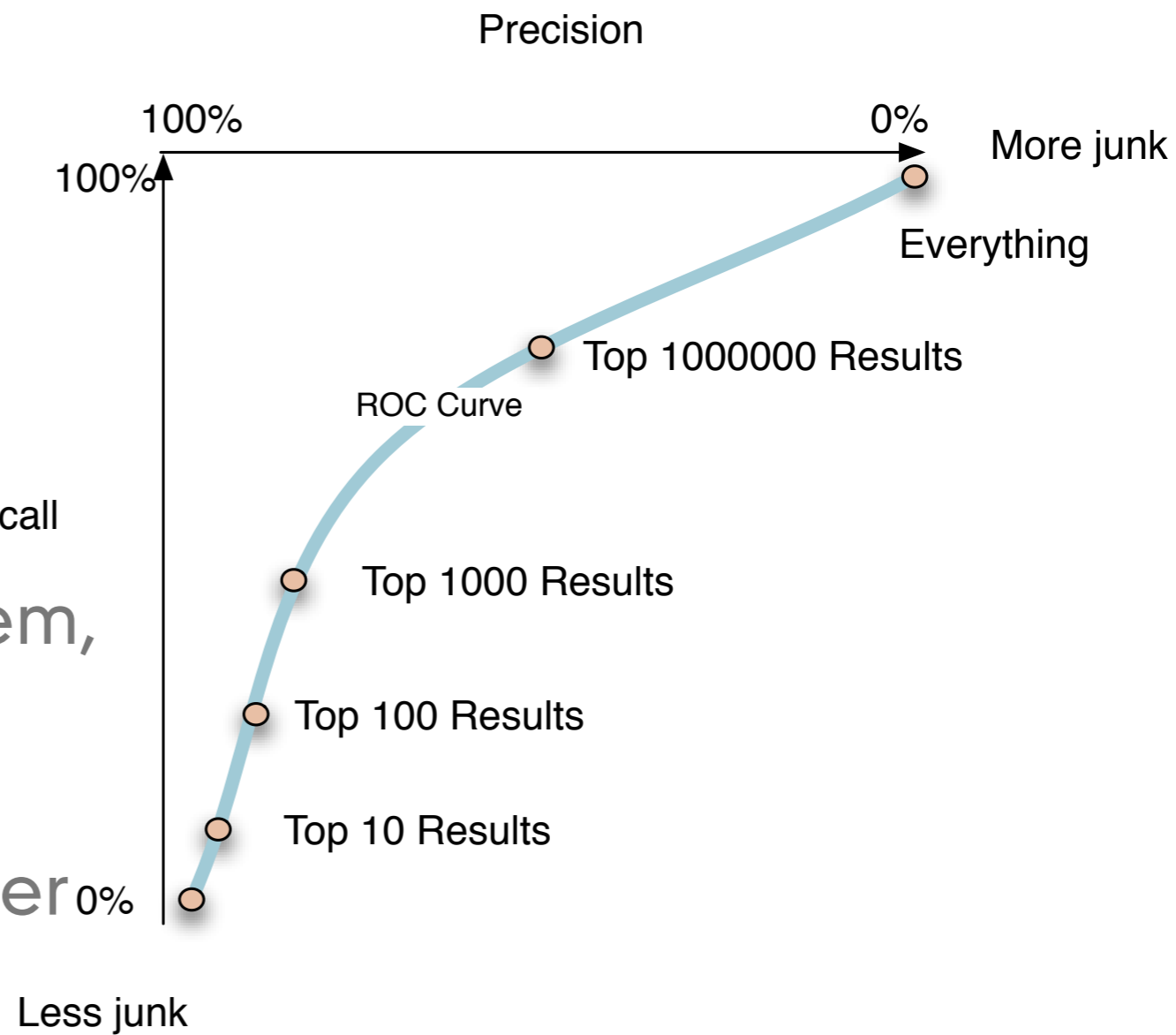
Ranked Retrieval

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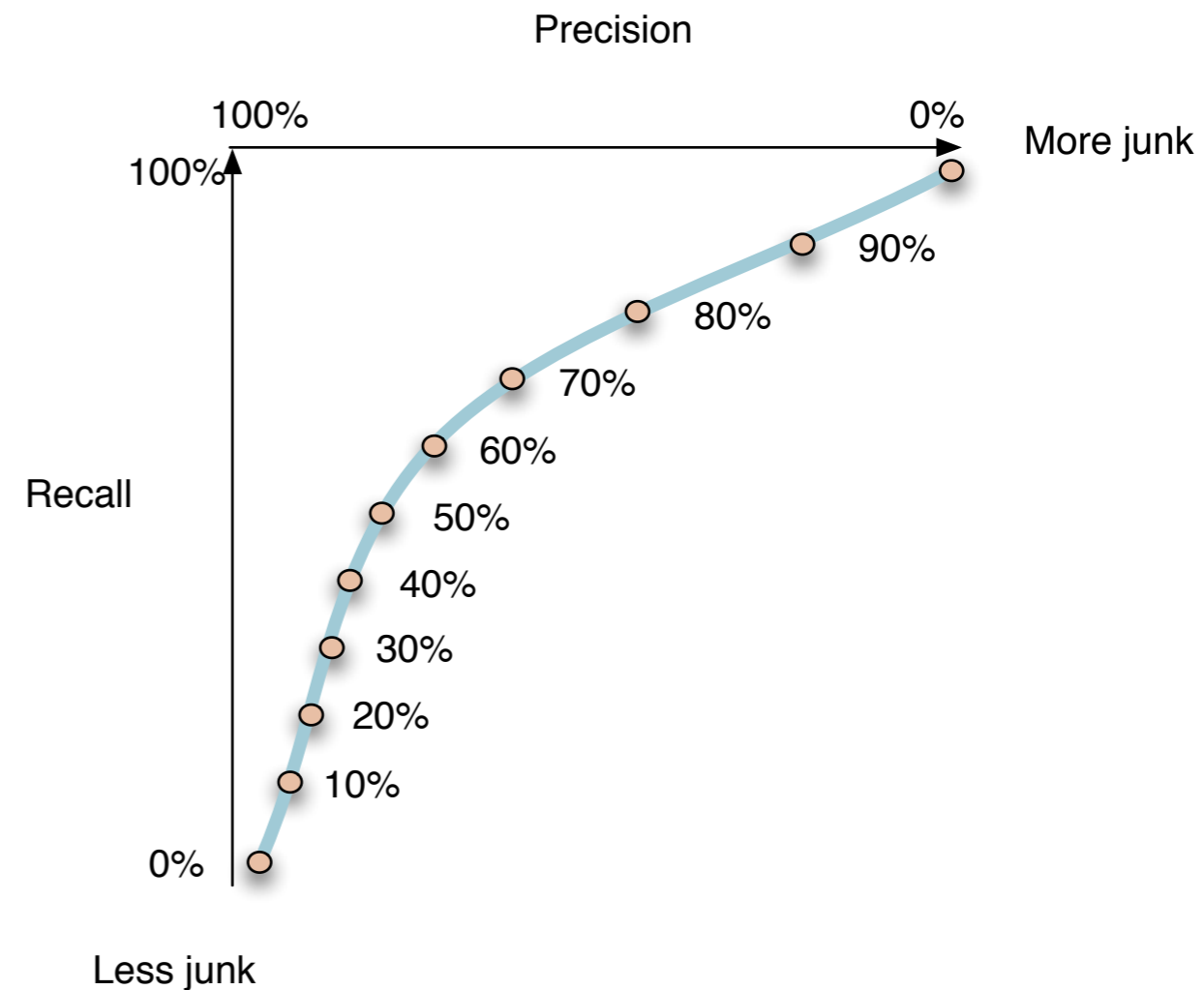
Ranked Retrieval

- One option is to average the precision scores at discrete points on the ROC curve
- But which points?
- We want to evaluate the system, not the corpus
- So it can't be based on number of documents returned



Ranked Retrieval - 11 point precision

- Evaluate based on precision at defined recall points
- Average the precision at 11 points
- This can be compared across corpora
- because it isn't based on corpus size or number of results returned



Ranked Retrieval - Mean Average Precision

- Why just 11 points?
- Why not average over all points?
- This is roughly equivalent to measuring the area under the curve.

