



Personalized User Profiling for Time-Dependent Recommendation of Structured Products (2016)

By Richard Searle & Megan Bingham-Walker
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Presented by:

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at RecProfile Workshop, RecSys '16



relevance & time



Rex Rizzo
@RexRizzo



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Wired: "Machine learning will TAKE OVER THE WORLD!"

Amazon: "We see you bought a wallet. Would you like to buy ANOTHER WALLET?"

RETWEETS

7,323

LIKES

10,048





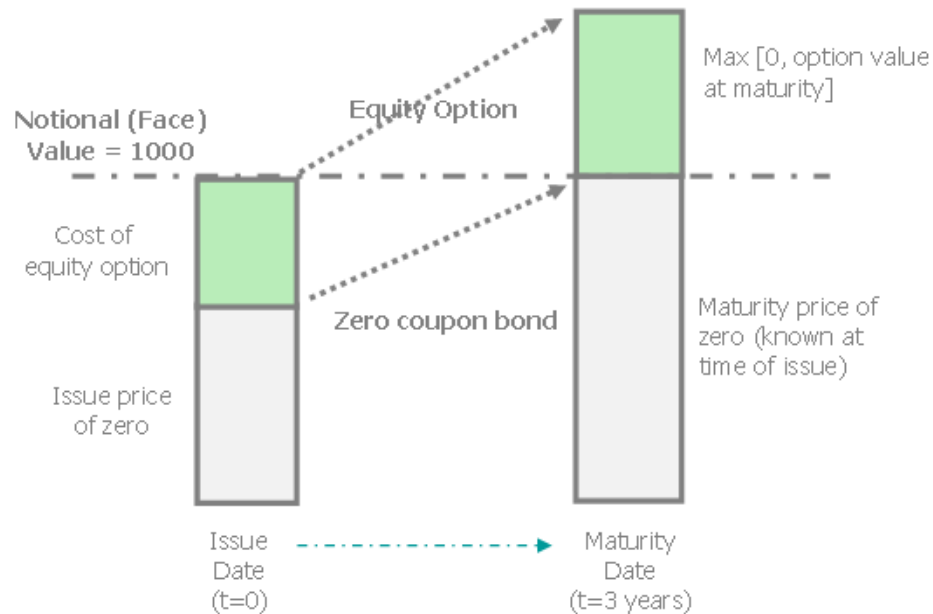
case study

- Aiming to identify products that are relevant to users at a point in time, based on membership of communities of similar users.
- Approximate measure of success (ground truth) was if communities identified by the model correlated with traded products.
- Learning a representation of a semi-open domain (products and users).
- The key to maintaining **efficient performance + accuracy** was rapid dimensionality reduction & clustering analysis on only the most relevant relationships within the model, without loss of data.
- Generic system



relevance and time

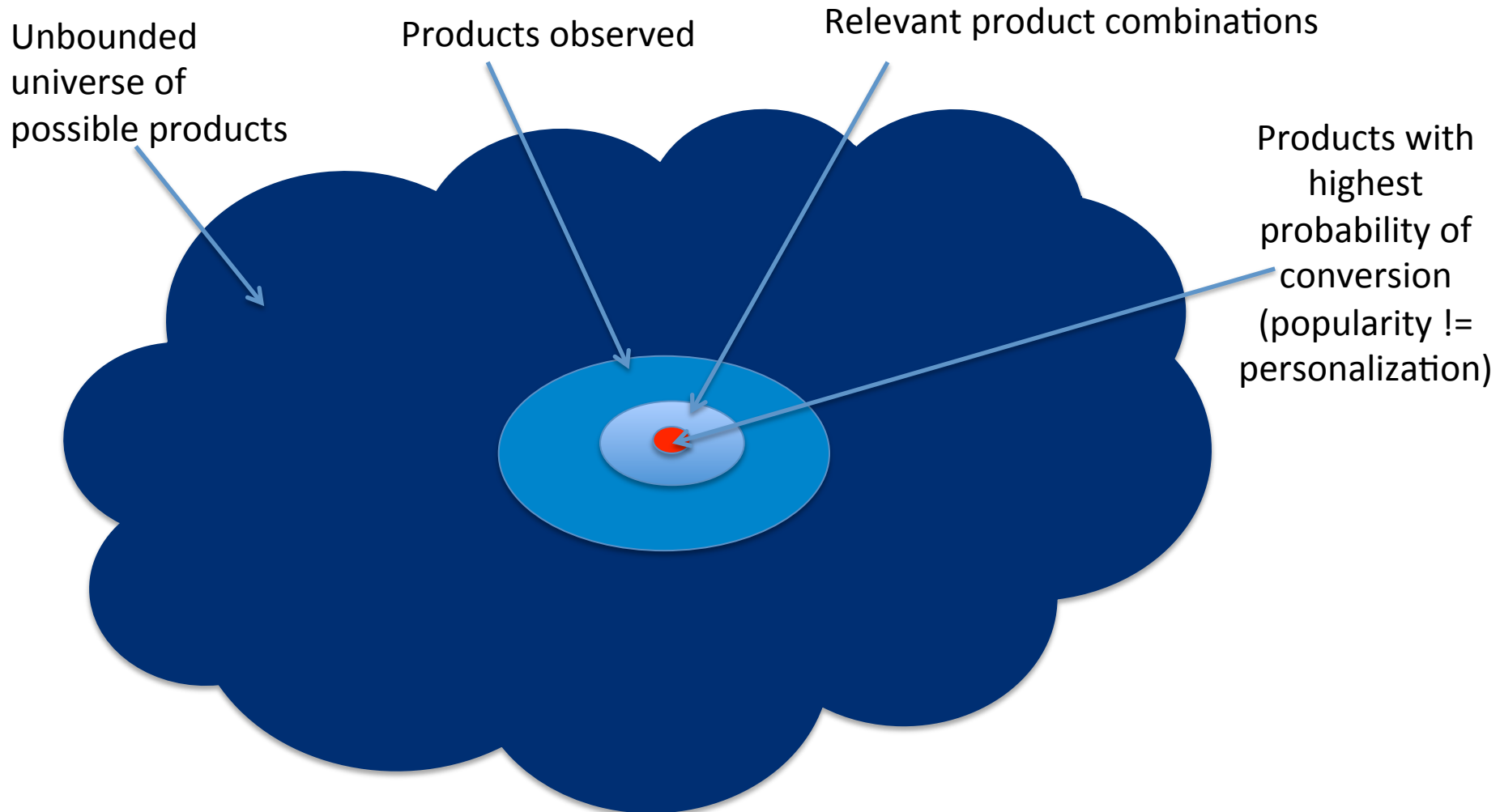
- A **structured product** is an investment product that comprises a basket of underlying financial instruments, eg equity, debt, commodities, currencies etc.
- Rapidly changing:
 - product combinations
 - product prices
 - product lifecycles/maturity
- Latent variables & sparsity



Source: http://www.investopedia.com/articles/optioninvestor/07/structured_products.asp



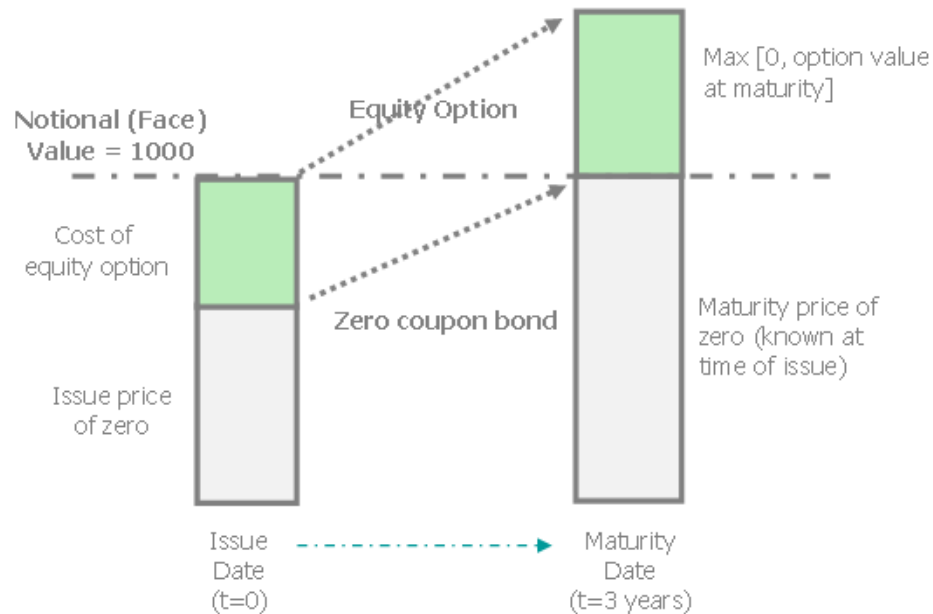
efficient compression





data

- 31 consecutive days of price request data.
- 60,510 anonymous price request samples.
- 1,450 underlying assets which occurred with a maximum frequency of 5.6%.
- Number of possible product compositions is combinatorially explosive.

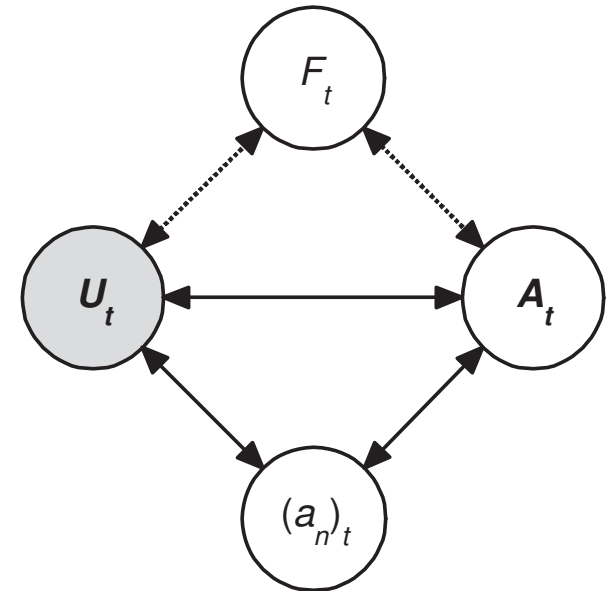


Source: http://www.investopedia.com/articles/optioninvestor/07/structured_products.asp



methodology

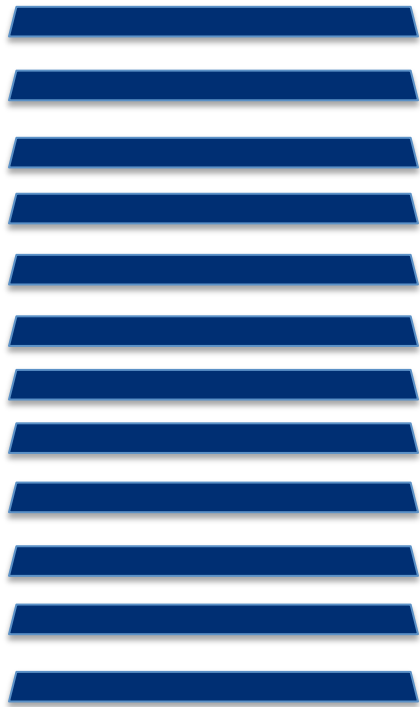
- ***All relationships (item to user, user to user and user to item) perceived by the system retained within the domain representation.***
- Undirected graph, G , with set of vertices, representing users (U), structured product (A) & underlying assets (a), which feed into client's internal assessment of the user (F).
- ***Flexibility to interrogate model vertex similarity to any degree of freedom.***
- Undirected edge relationships with similarity characteristic (S_{ij}) which varies in proportion to the threshold parameter (p) at a point in time.
- ***Temporarily masking edges with similarity coefficients below the threshold value gives a dynamic morphology that is independent of the composition of the domain + conditional to query.***





dynamic model

Lifetime history of
price requests



Compression
algorithm



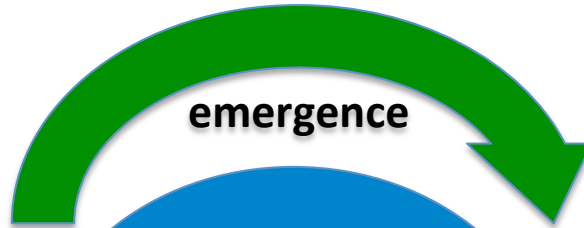
**DYNAMIC
GRAPHICAL
MODEL**

Clustering
& Ranking



**DYNAMIC
PROFILES**

emergence



decay





clustering & ranking

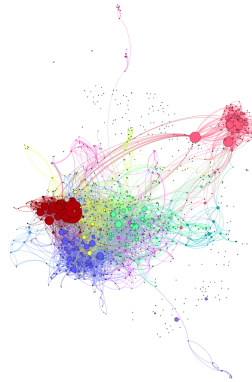
step	explanation
1	Fast approximation of network communities using the <i>Louvain</i> algorithm (Bonnel et al, 2008).
2	Consensus clustering to further resolve community boundaries by concentrating selection on co-clustered vertices. (Fortunato & Lanchinetti, 2012).
3	Ranking communities according to their significance to a user (because user could be a member of multiple communities).
4	For each relevant community, compute mean-path-rank of possible product combinations and select optimal product for the user or a group of users.



graph morphology



Day 1:
10 price requests
2 Communities
5 Dimensions
14 nodes
24 edges



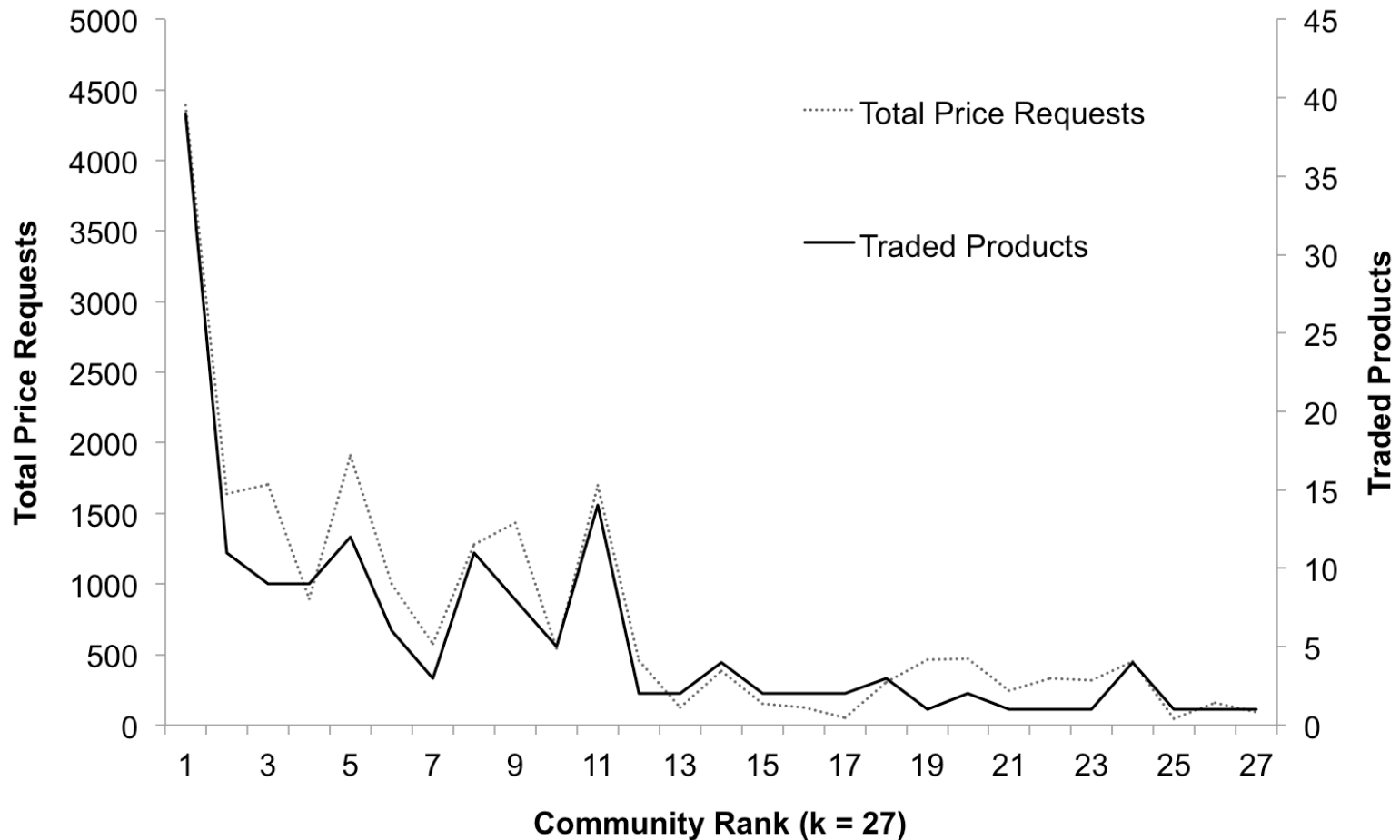
Day 10:
20,572 price requests
27 Communities
1,021 Dimensions
21,583 nodes
53,364 edges



Day 31:
60,510 price requests
27 Communities
1,446 Dimensions
61,925 nodes
154,088 edges

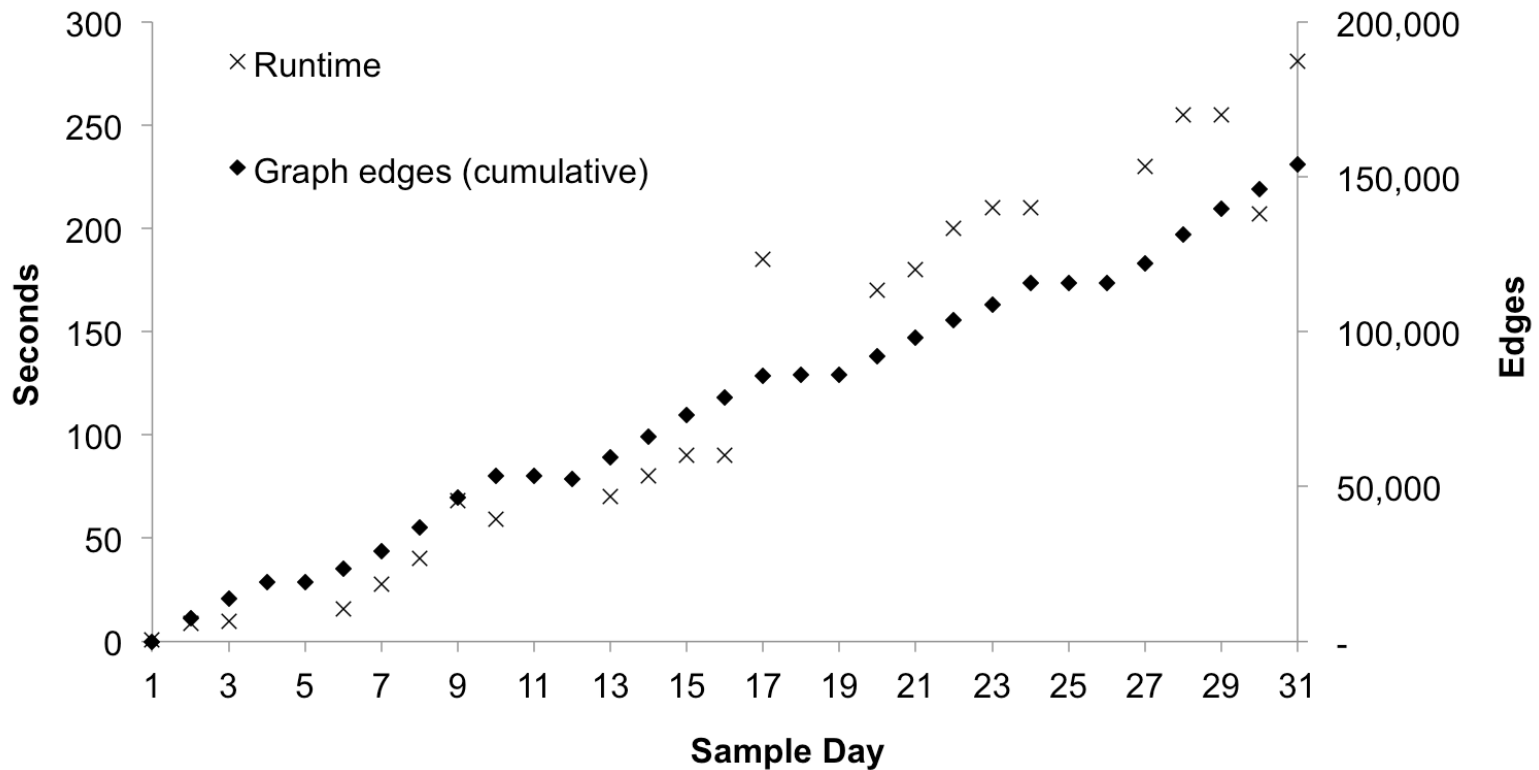


communities on day 31





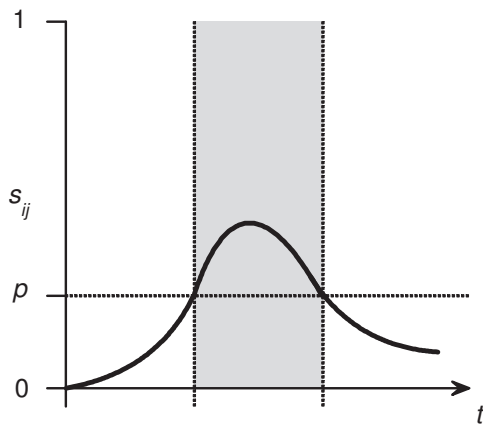
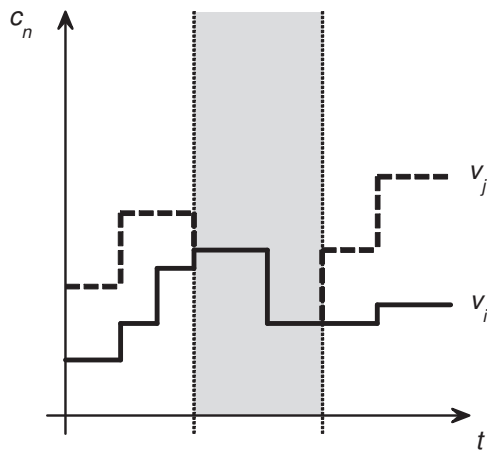
runtime vs size of model



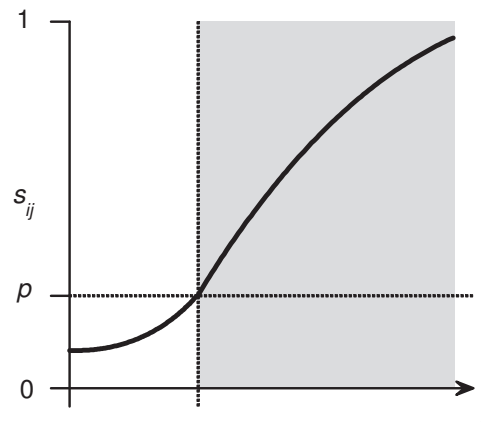
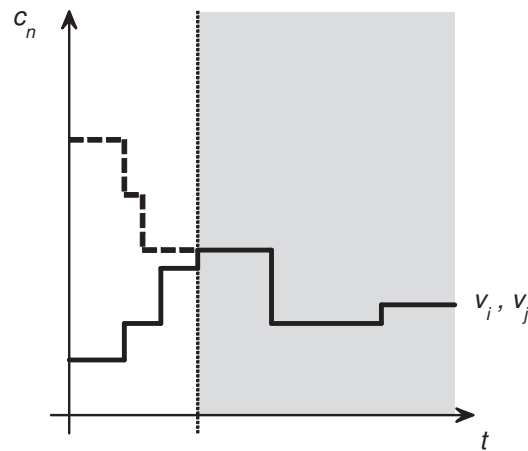
Without system optimization or parallel processing



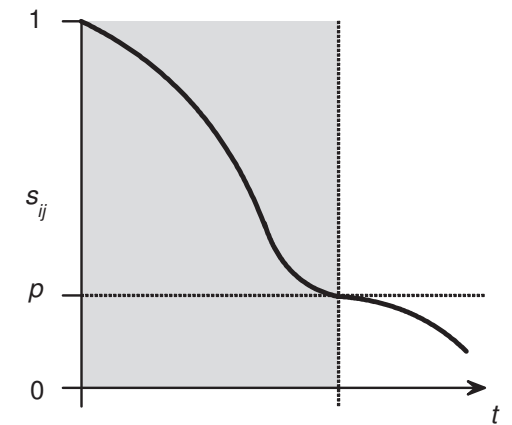
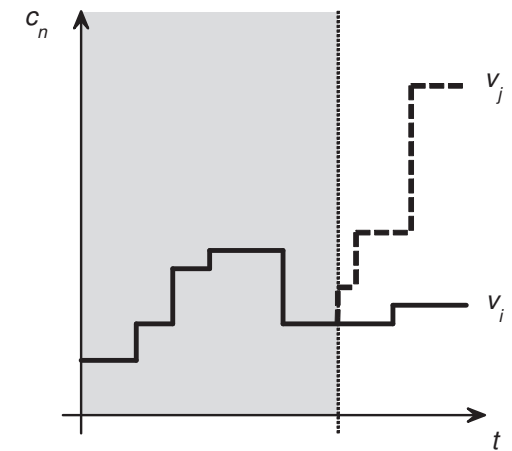
community membership



(a) Transient Associativity



(b) Temporal Convergence



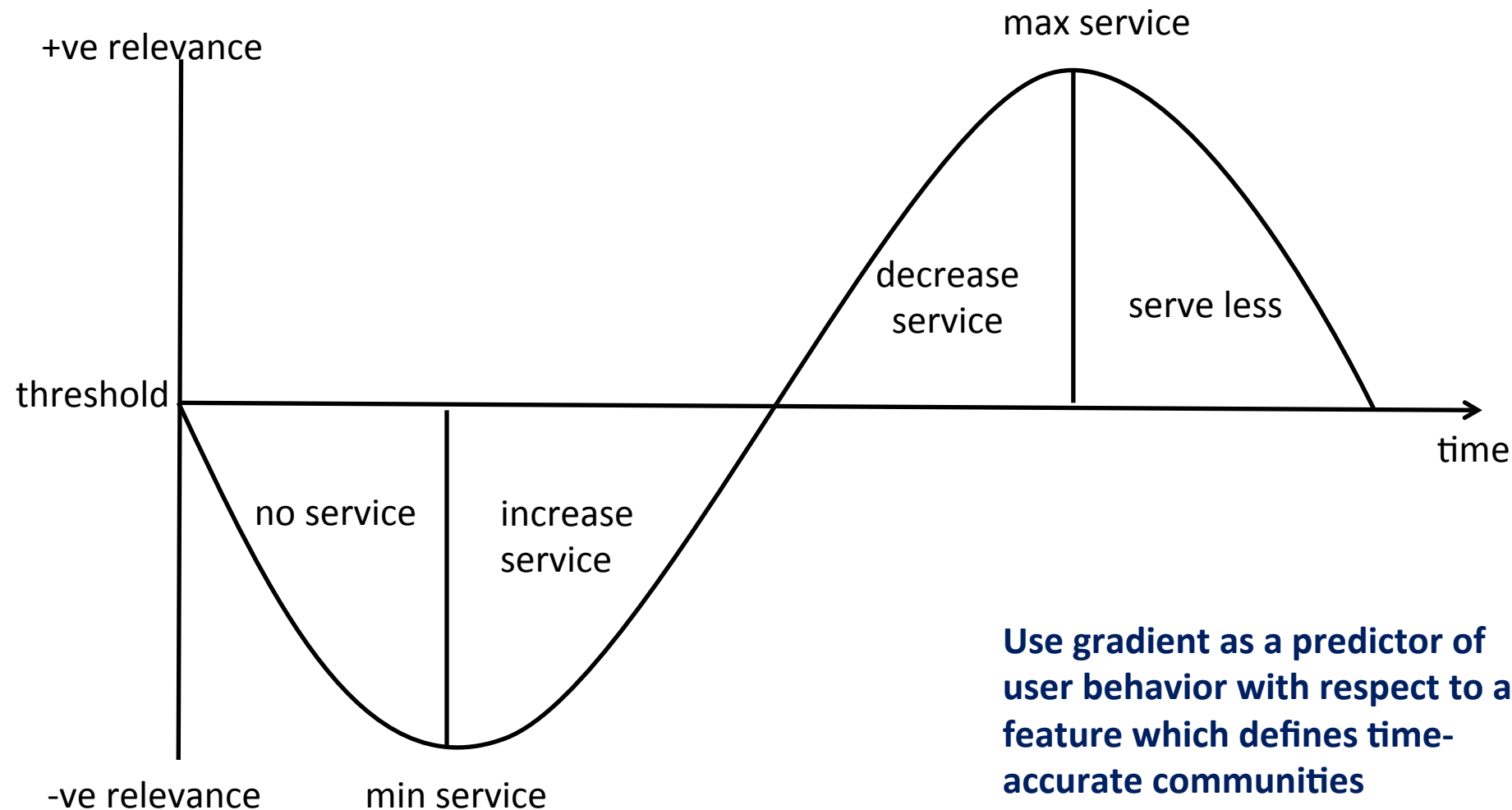
(c) Temporal Divergence



future work

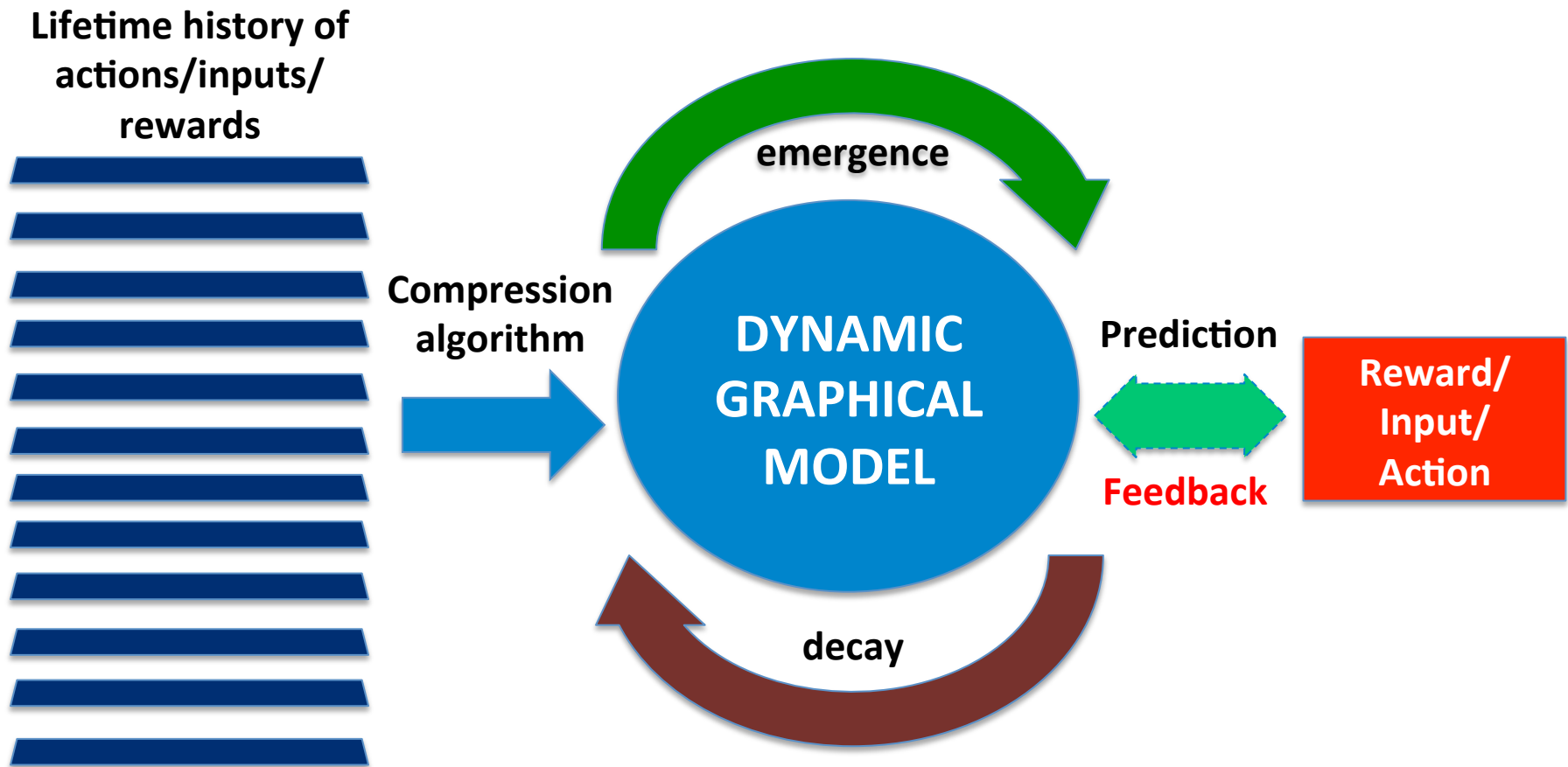


relevance over time





add feedback





thank you!



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