Understanding Service Engagements

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Outline

Technical Service

Characterized by transfers of bits

- Generally, an abstraction of a computational object
  - Traditional, as in web or grid services
  - Improved: Abstraction of a "capability"
- Well encapsulated, i.e., a black box
- Interface defined at the level of methods or messages

Business Service

Characterized by transfers of value

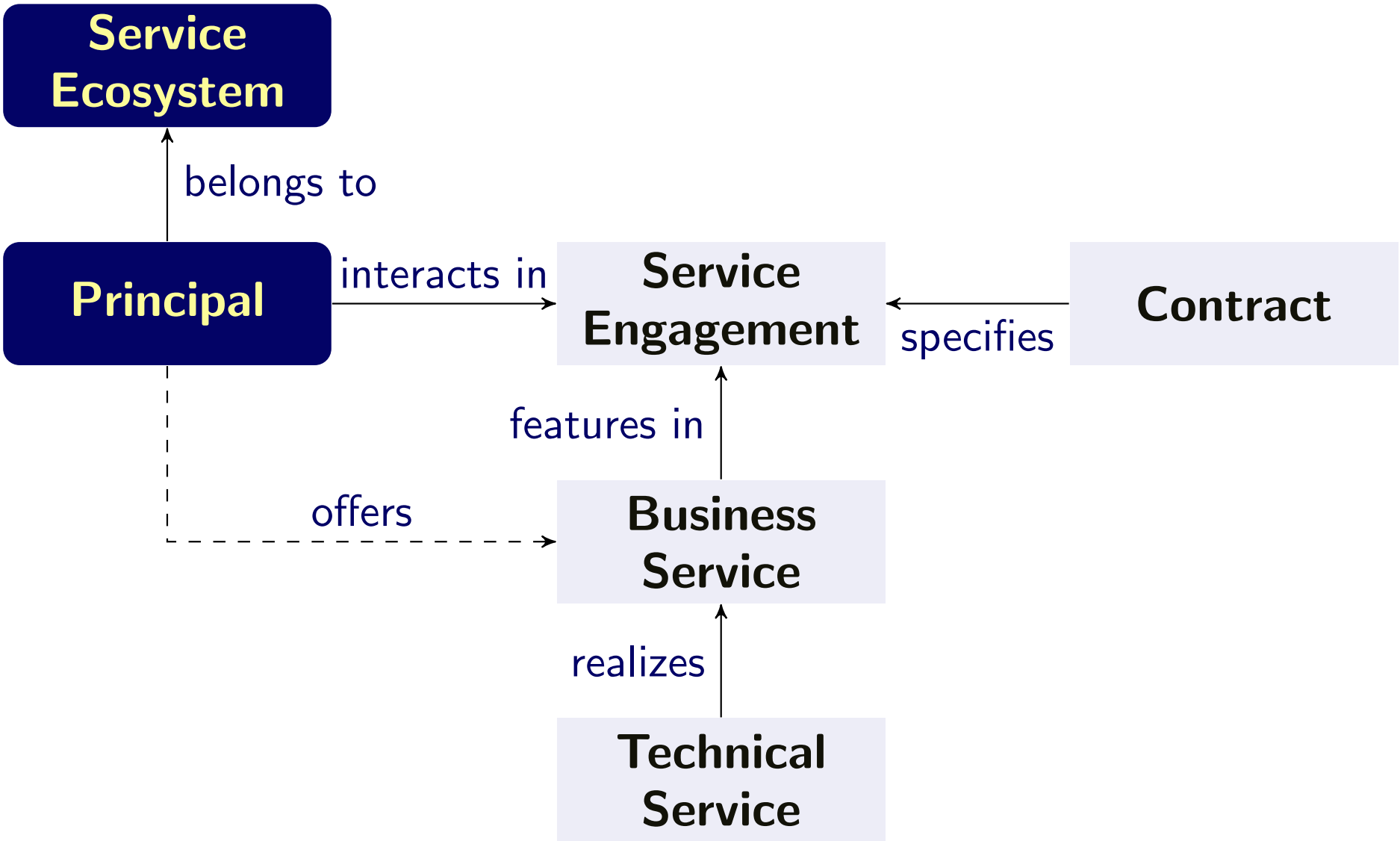
- Typically long-lived with on-demand enactments
- Instantiated on the fly, unlike goods or products
- Though may be
  - Constructed using goods
    - Data center provisioning
    - Installation
  - About goods
    - Maintenance
- Not perfectly encapsulated, i.e., a gray box
- Interface defined at the level of business events

Service Engagement

An aggregation of business relationships and services in action

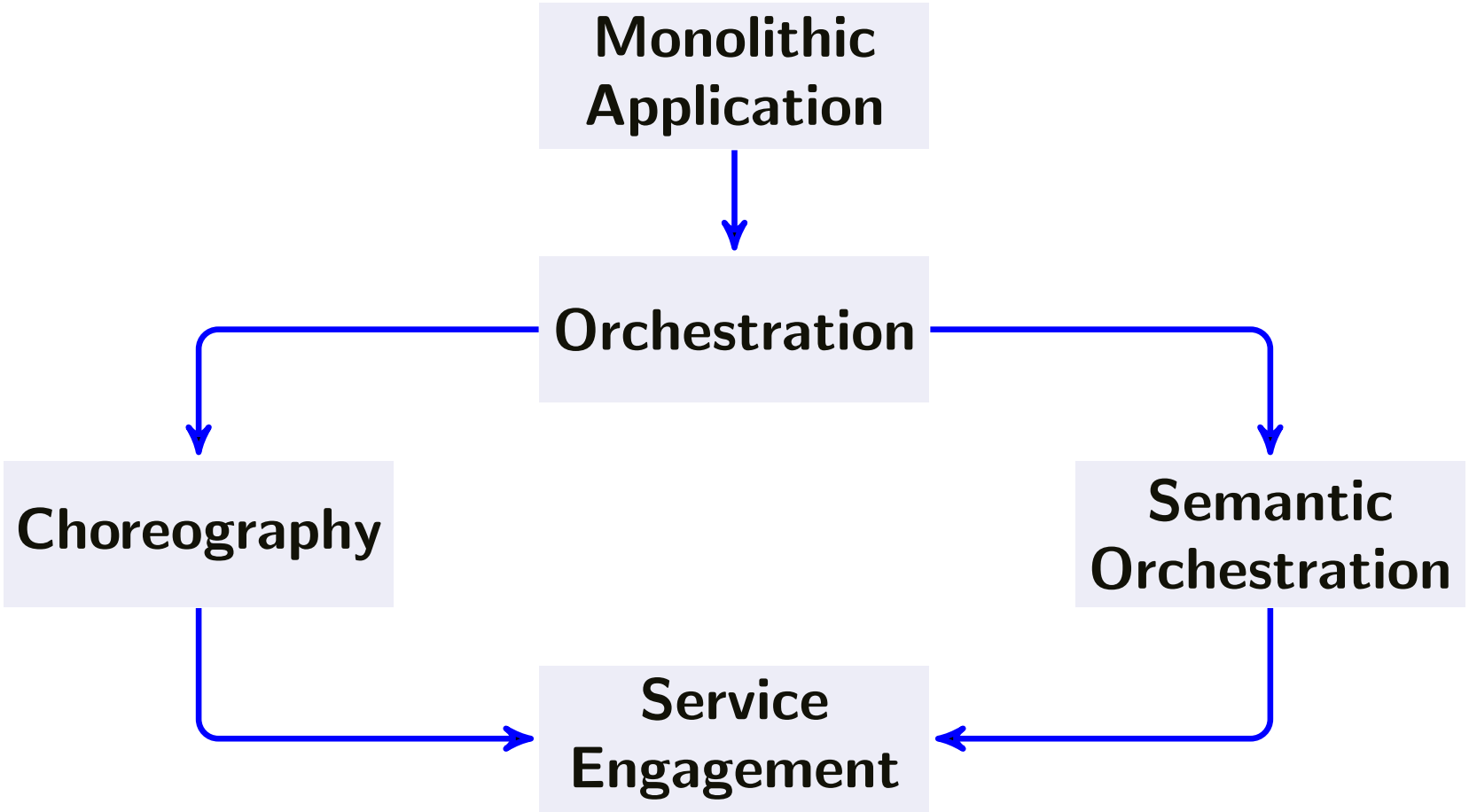
- Characterized by
  - Independence of principals, i.e., business partners
  - *Coproduction*
    - Participation by all, though not at the same level
    - Symmetric relationships: complementary capabilities and goals
    - Produced on demand
    - Participants provide business services to one another
- Specified via contracts

Services Conceptually



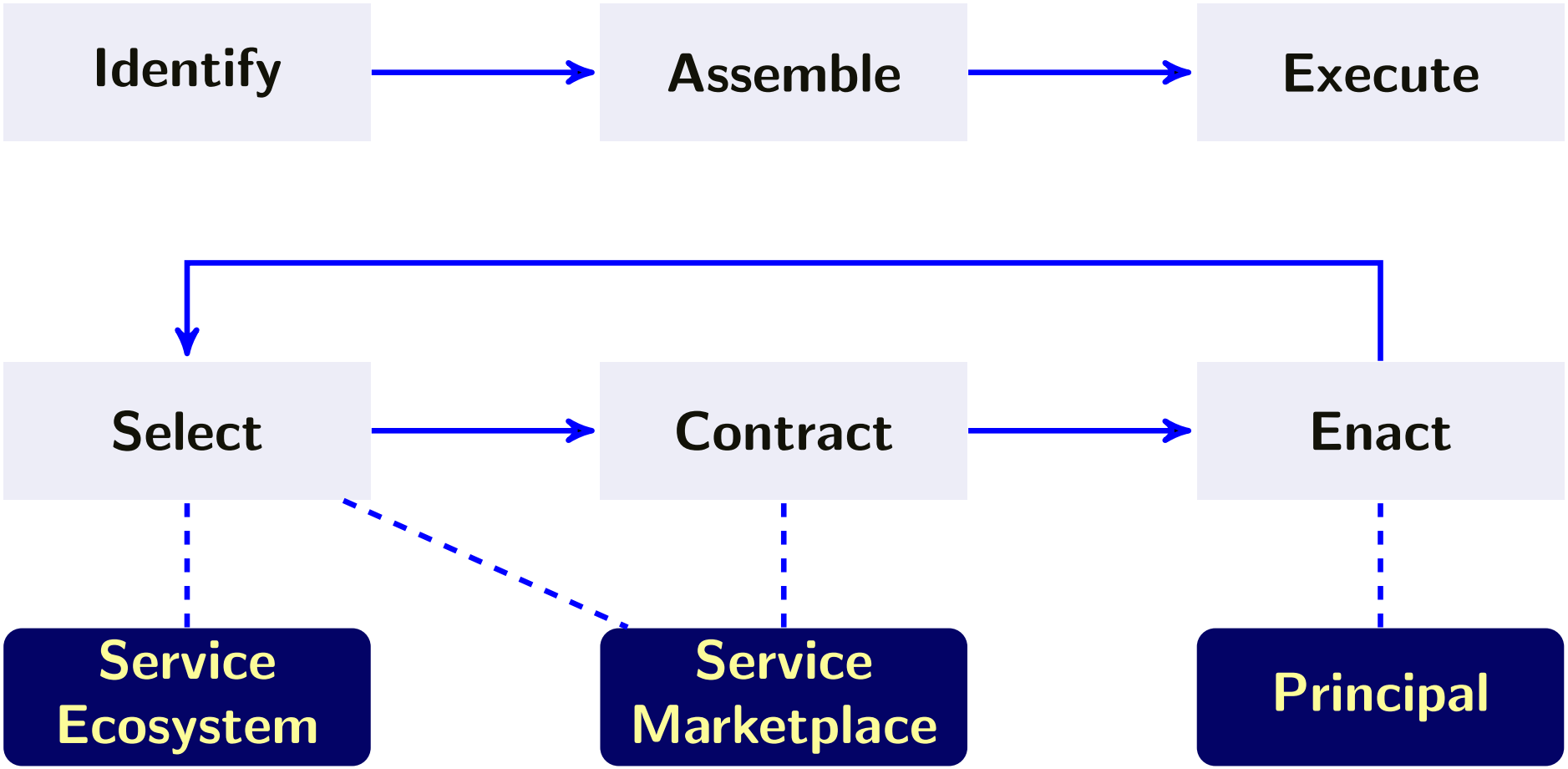
The Evolution of IT

Shift from technical to business representation



Elements of an IT Episode: Traditional and for Services

Traditionally, no support for autonomy



Directions for Research

- Selection: Multiple perspectives on creating engagements
  - Social networks for reputation and referral
  - Selecting service coalitions and services for coalitions
  - Estimating trust
- Contracting: Specifying the rules of encounter
  - Specifying models of quality and utility
  - Pricing and economic incentives
  - Modeling exceptions and opportunities
  - Engendering trust
- Enacting: Technical infrastructure to facilitate new business models
  - Cloud computing as a foundation for service clouds
  - Ad hoc processes
  - Accommodating unexpected exceptions and opportunities
  - Decentralized enactment: doing without a process orchestrator

Outline

What is a Contract?

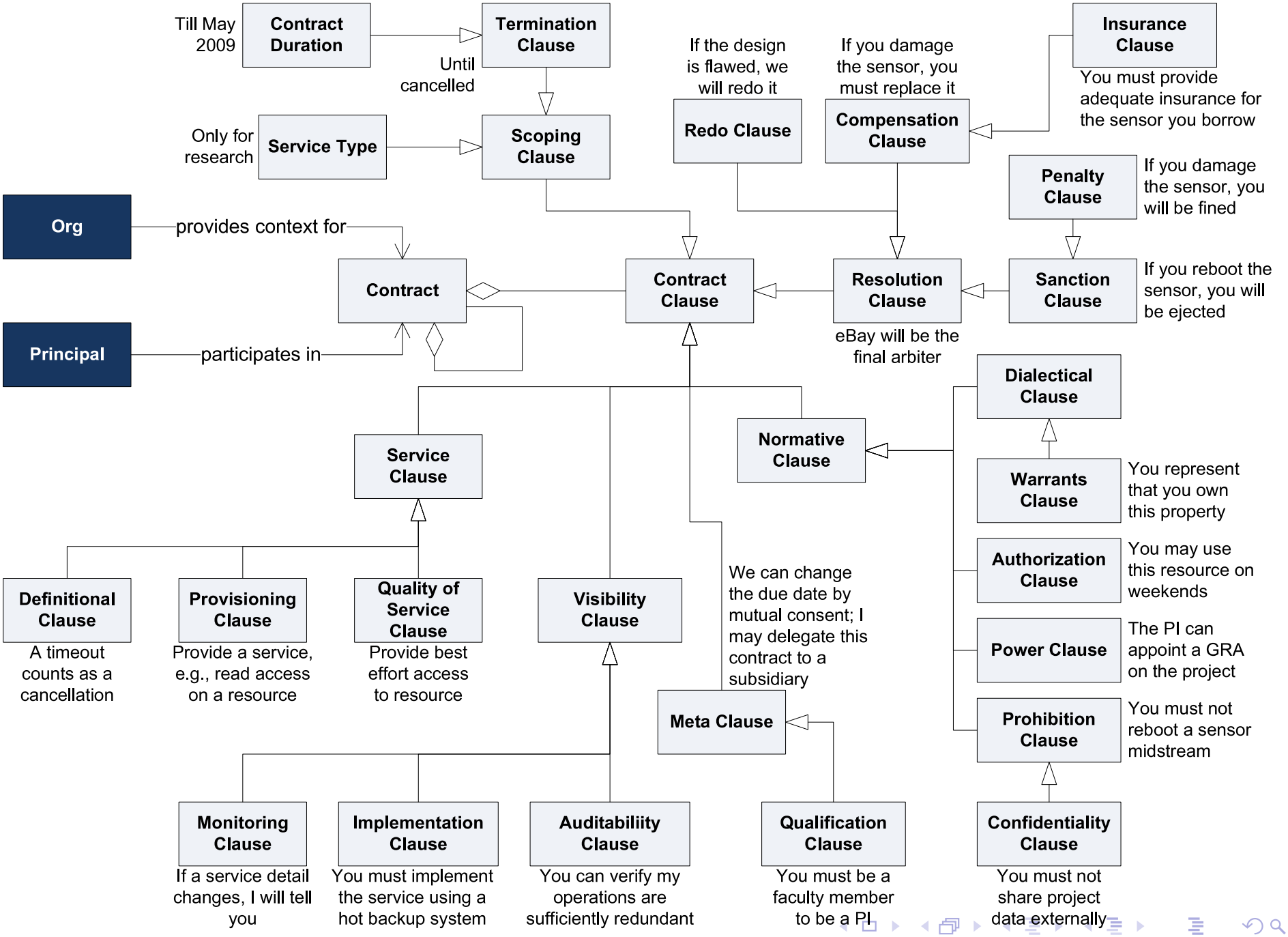
A reusable description of business-level interactions that preserve participants' autonomy

- Specifies how business events and interactions affect state
  - Capturing commitments on a business partner playing a role
- Specifies well-defined roles
  - Setting policies for how to enact a contract
- Stored in a repository
  - As an asset in its own right
  - Refined and composed for implementation

Contracts Specify Service Engagements

Crucial in open environments

- Emphasize interactions: observable by others
- Constrain interactions: limit autonomy
- Disregard internal implementations, thus facilitating heterogeneity
  - Except where a gray box is appropriate
- Embody a lot of subtlety as shown in our proposed model, next


Till May 2009
Contract Duration
Termination Clause
Until cancelled
Only for research
Service Type
Scoping Clause
If the design is flawed, we will redo it
Redo Clause
If you damage the sensor, you must replace it
Compensation Clause
Insurance Clause
You must provide adequate insurance for the sensor you borrow
Penalty Clause
If you damage the sensor, you will be fined
Org
provides context for
Contract
Contract Clause
Resolution Clause
Sanction Clause
If you reboot the sensor, you will be ejected
Principal
participates in
eBay will be the final arbiter
Dialectical Clause
Service Clause
Normative Clause
Warrants Clause
You represent that you own this property
Authorization Clause
You may use this resource on weekends
Power Clause
The PI can appoint a GRA on the project
Prohibition Clause
You must not reboot a sensor midstream
Definitional Clause
A timeout counts as a cancellation
Provisioning Clause
Provide a service, e.g., read access on a resource
Quality of Service Clause
Provide best effort access to resource
Visibility Clause
We can change the due date by mutual consent; I may delegate this contract to a subsidiary
Meta Clause
Monitoring Clause
If a service detail changes, I will tell you
Implementation Clause
You must implement the service using a hot backup system
Auditabiliity Clause
You can verify my operations are sufficiently redundant
Qualification Clause
You must be a faculty member to be a PI
Confidentiality Clause
You must not share project data externally

Juggling Contract: 1

Contract For: Canterbury Centre Dinner 2003 ("CCD"), Friday 6 June 2003, 24 High Street, Canterbury

This agreement is entered into between the University Juggling Club ("UJC") and the Canterbury Center Dinner 2003 on the following terms:

1. Service Provider: University Juggling Club.
2. Employer: Canterbury Center Dinner.
3. To be provided by UJC: Performers: J Woods (juggler); one other juggler; all equipment necessary for performance.
4. To be provided by CCD: Cloakroom.
5. Venue address: 24 High Street, Canterbury.
6. CCD understands that performances are restricted in venues with ceilings of insufficient height. The ideal height is 5 meters. Outside performances are restricted in rain or strong winds.
7. Date of Performance: Friday 6 June 2003, starting at 6:30PM.
8. Duration of Performance: 1.5 hours. Short (less than one minute) breaks are part of the performance.

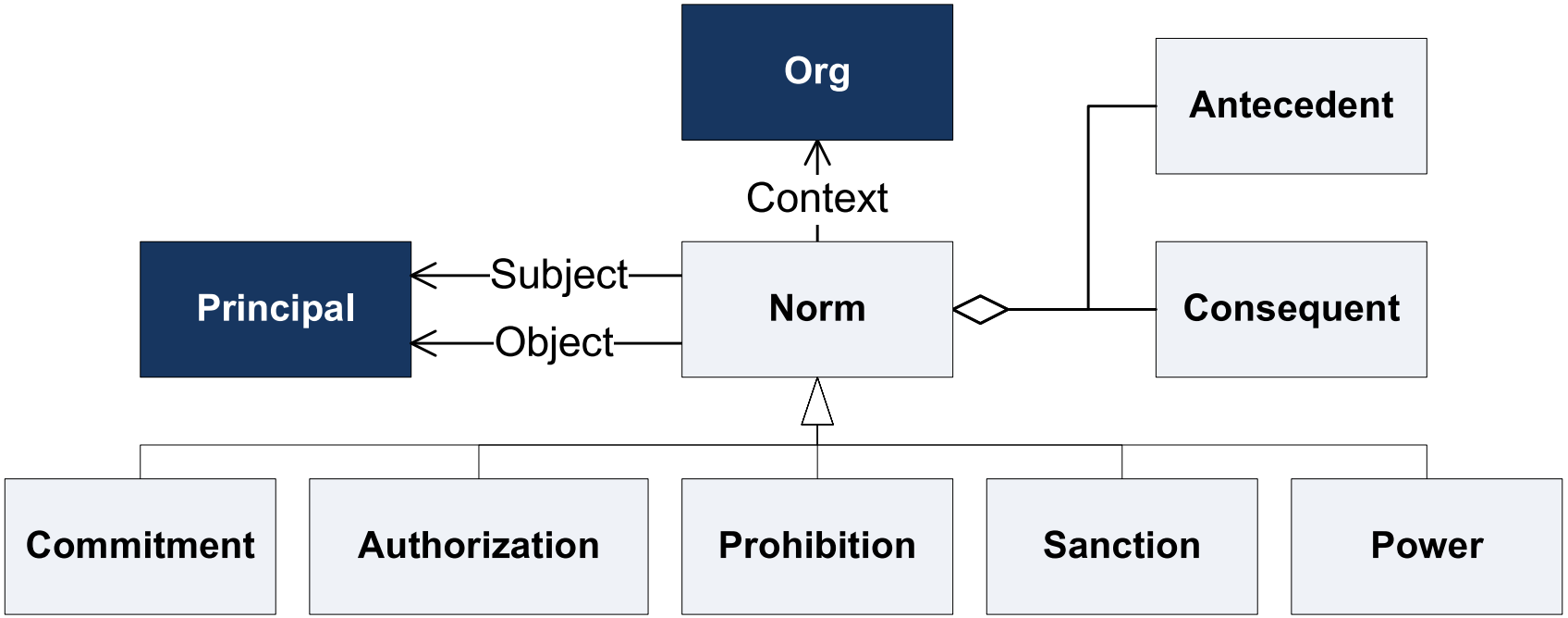
Juggling Contract: 2

9. Fee: £30 per juggler + £10 expenses + £90 insurance (total £160).
10. If UJC is forced to cancel, all monies (including £90 deposit) will be refunded in full. If the Employer cancels with at least 24 hours notice, UJC will retain £90 and return any other monies.
11. Should poor weather mean that the Event takes place indoors, UJC will refund £10 expenses.
12. Performers will not consume any alcohol until after completion of services as agreed.
13. CCD will be responsible for compensation to UJC for damage to equipment caused by those attending the Event unless damage is caused when (if) Performers have left equipment unguarded.
14. UJC will be liable for any injury sustained by a guest at the Event if such injury results from provision of services as agreed upon in this contract unless the Event fails to provide a suitable area for performance.

Outline

Types of Normative Relationships Seen in Contracts

Unified logical form: Norm(subject, object, context, antecedent, consequent)



- Directed
- Declarative
- Composable
- Manipulable

Semantic Verb Classes: 1

- *State*
  - Examples: Retain, have, be, own, remain, include
  - Dialectical Commitment: Each joint owner shall **have** an equal and undivided ownership interest in the Joint Works ...
- *Event*
  - Examples: Move, perform, deliver, notify, market
  - Practical Commitment: Sharp shall **provide** Approved Carriers and Carrier Customers with Products for testing, evaluation and field trials in accordance with terms agreed upon between Sharp and such parties

Semantic Verb Classes: 2

- *Physical*
  - Examples: Produce, pay, develop, utilize, design
  - Authorization: Danger will have the right to **use** the test results internally for product management and planning purposes
- *Social:*
  - Examples: Terminate, sell, approve, waive, purchase
  - Power: In the event this Agreement terminates for a reason other than for Danger's material breach, Danger shall have the right to **purchase** any Sharp owned tooling and test equipment for a Product at a reasonable price

Key Textual Features with Examples

Subject contains organization name	Motorola; Google
Clause signal	if; unless
Modal verb	may; should
Negation present	not; neither
Only present	only
Main verb expresses an event	deliver; perform
Main verb expresses a state	have; be
Main verb has physical consequence	produce; pay
Main verb has social consequence	terminate; approve
Practical commitment signal	agree to
Dialectical commitment signal	it warrants; it is understood that
Authorization signal	shall have the right to ⟨physical⟩
Prohibition signal	must not
Power signal	shall have the right to ⟨social⟩
Sanction signal	responsible for any breach

Experimental Setting

- Gold standard
  - Selected 1,000 sentences from real-life contracts
  - Remove 38 sentences longer than 80 words each (often broken) to reduce noise and processing overhead
  - Remove 94 duplicate sentences
  - 868 sentences left after cleansing
  - Manually annotate each sentence with its norm type
- Features
  - Manually selected and automatically extracted
- Classification methods
  - Support Vector Machine (SVM)
  - Logistic regression (LR)
  - Naïve Bayes (NB)
- Evaluation
  - Ten-fold cross validation
  - Test on fresh data with model built from gold standard

Extraction Results (Ten-Fold Cross Validation)

Class	**LR**			**SVM**			**NB**		
	P	R	F	P	R	F	P	R	F
Practical C	0.87	0.80	0.83	0.88	0.70	0.78	0.83	0.81	0.82
Dialectical C	0.75	0.79	0.77	0.67	0.84	0.74	0.69	0.83	0.76
Authorization	0.67	0.69	0.68	0.68	0.65	0.66	0.65	0.76	0.70
Prohibition	0.64	0.68	0.66	0.64	0.61	0.63	0.68	0.59	0.63
Power	0.74	0.78	0.76	0.69	0.76	0.72	0.78	0.66	0.72
Sanction	0.43	0.25	0.32	0	0	0	0	0	0
Not a norm	0.58	0.47	0.52	0.42	0.33	0.37	0.6	0.2	0.3
Average	*0.75*	*0.74*	*0.74*	*0.71*	*0.71*	*0.71*	*0.72*	*0.73*	*0.72*

Outline

Identifying Commitment Operations from Interactions

Ten-fold cross-validation using SVM on marked up Enron email sentences

Commitment Operation	**P**	**R**	**F**	**Count**
Commissive create	0.87	0.97	0.92	342
Directive create	0.94	0.97	0.95	162
Delegate	0.86	0.33	0.48	12
Discharge	1	0.02	0.04	38
Cancel	0	0	0	7
None	0.98	0.98	0.98	3,540
Total				4,101

Notice the skewed distribution. Some of the features used in the classifier are

1. Modal verb (shall, will, may, might, can, could, would, must)
2. Type of subject (first person, second person, third person)
3. Tense
4. Deadline

Determining Commitment Operations from Text

Commitments being the most prominent normative relationship

S	R	Content	Operation	$\mathbf{T}_{S,R}$	$\mathbf{T}_{R,S}$
Kim	*Dorothy*	I will also check with Alliance Travel Agency ...	create(C_1)		
Kim	*Dorothy*	I checked with our Travel Agency ...	discharge(C_1)		$\uparrow$
Rob	*Kim*	By Wednesday Aug 16 2001, please send all copies of your documentation ...	create(C_2)		
Kim	*Rob*	Rob, please forgive me for not sending this in by Aug 15	cancel(C_2)		$\downarrow$

Estimating Trust from Commitment Progression

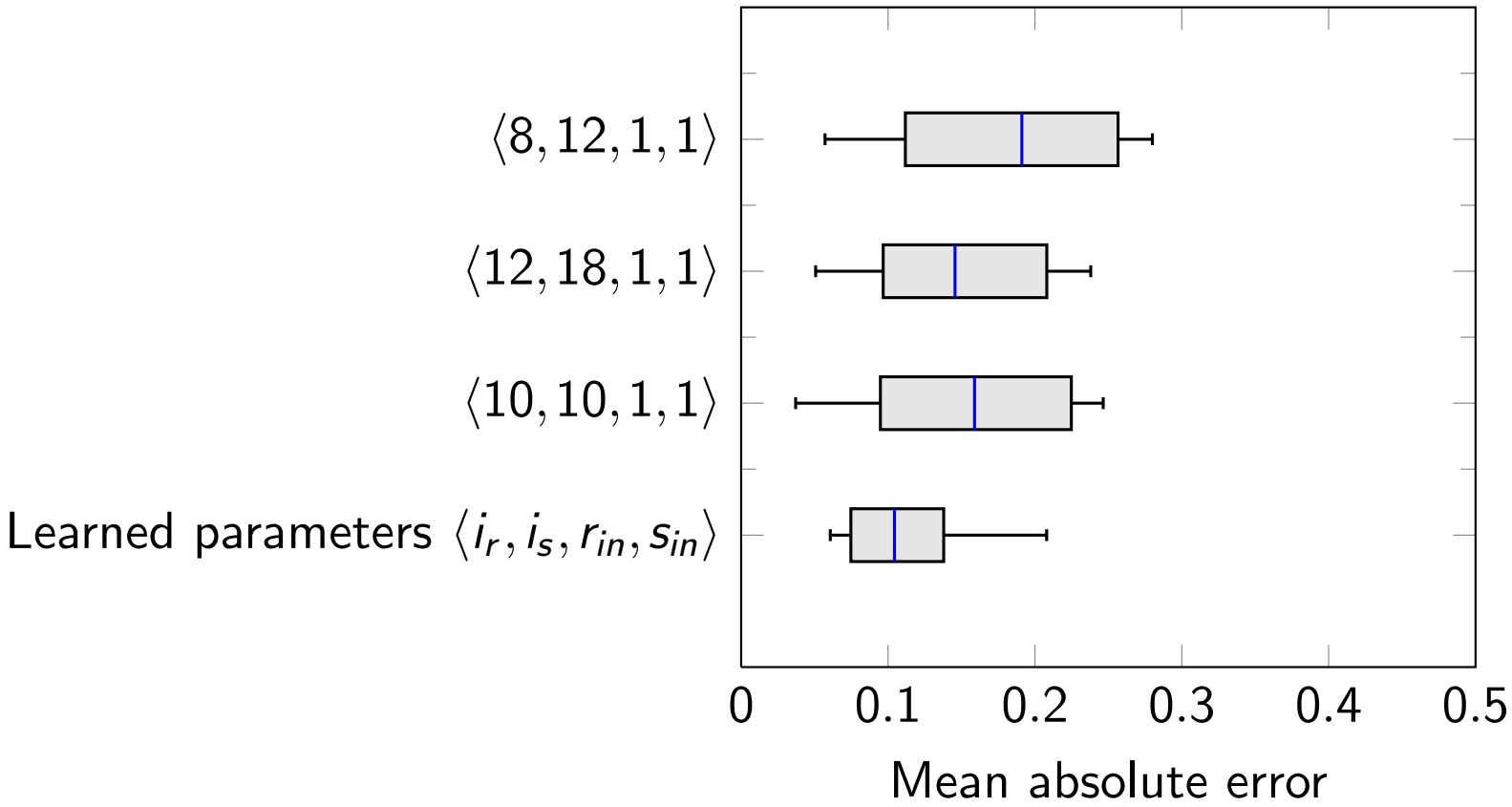
Simplistic model of a human subject

- Two-valued representation, positive and negative experiences: $\langle r, s \rangle$
- Trust $\alpha = \frac{r}{r+s}$
- Characterize each subject via four parameters
  - Initial values, $\langle r_{\text{in}}, s_{\text{in}} \rangle$
  - Increment for positive and negative interactions: i_r and i_s

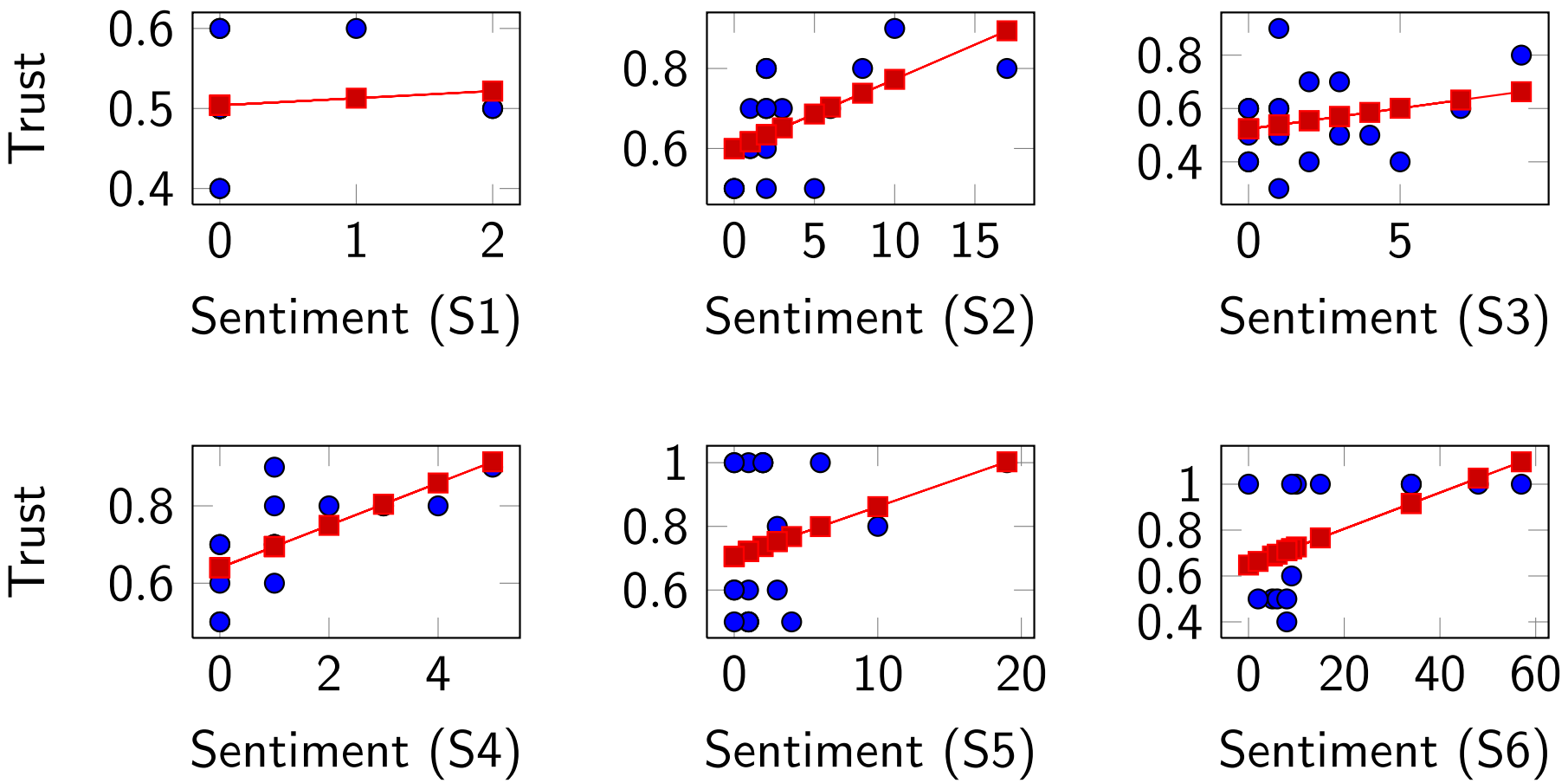
Commitment Operations	**Trust** $\langle r_{out}, s_{out} \rangle$
Create	$\langle 0.5 i_r + r_{in}, 0.5 i_s + s_{in} \rangle$
Delegate	$\langle 0.5 i_r + r_{in}, 0.5 i_s + s_{in} \rangle$
Discharge	$\langle i_r + r_{in}, s_{in} \rangle$
Cancel	$\langle r_{in}, i_s + s_{in} \rangle$
None	$\langle 0.5 i_r + r_{in}, 0.5 i_s + s_{in} \rangle$

Results: Prediction Error for Subjects' Ratings on Enron

Subjects marked up 5,487 sentences from emails exchanged by one selected Enron employee (each with inferred trust value and sentiment)

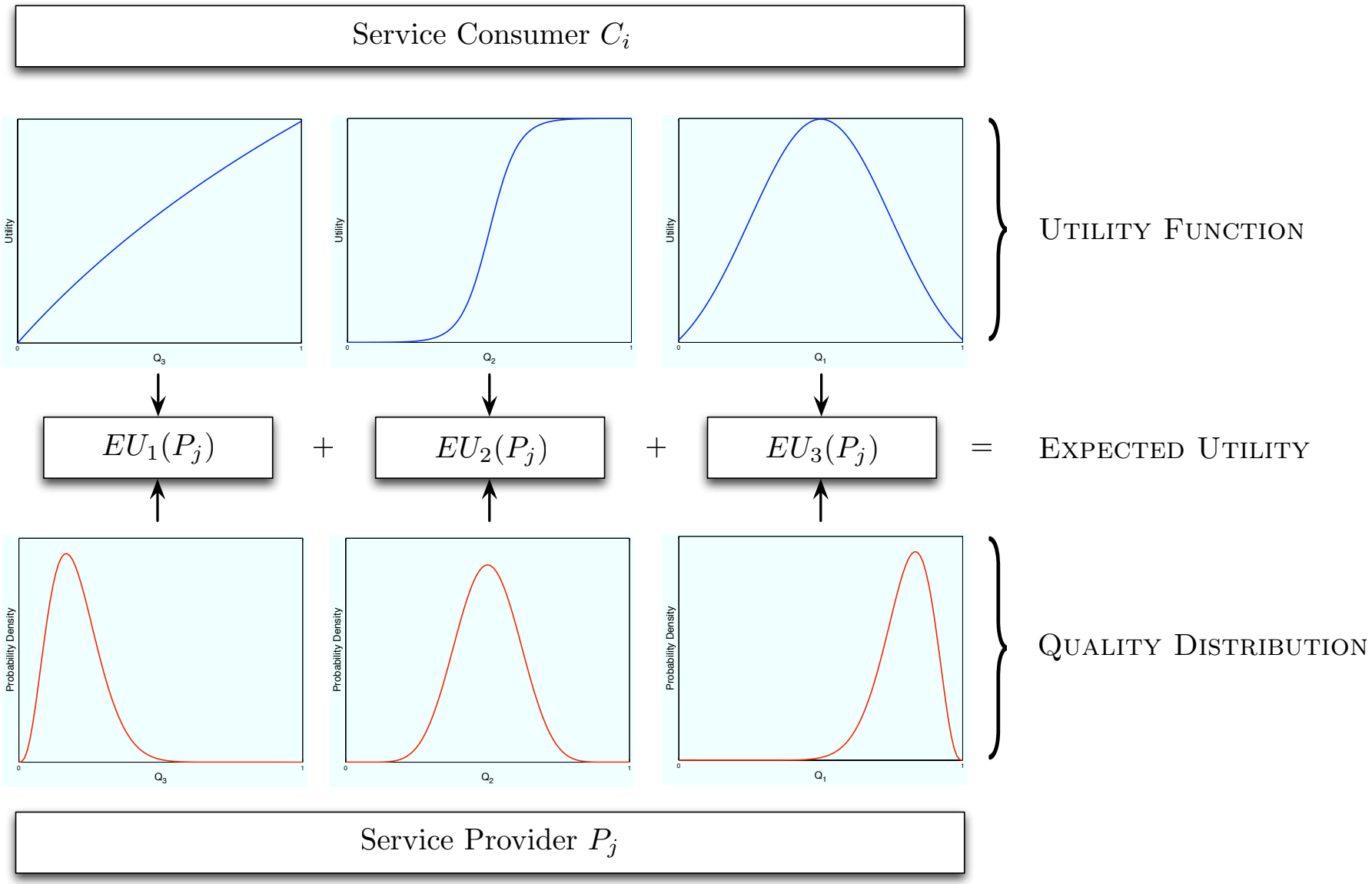


Results: Higher Trust Correlates with Positive Sentiments



Outline

Adaptive Service Selection Framework



Trust: Collect Quality Information

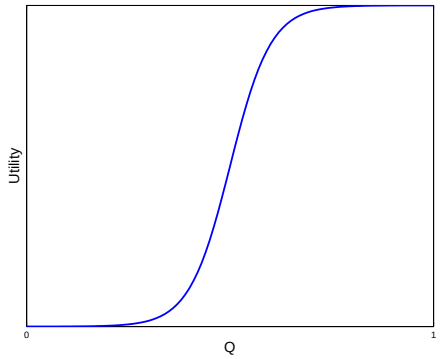
- Decide
  - Whether to rely upon someone for taking a specified action
  - Which service to use
  - Which information to believe
- Represent quality information as a probability distribution

Benefits

- Provide both expected quality and confidence
- Learn from direct and indirect (referral) experience
- Deal with dynamic behavior

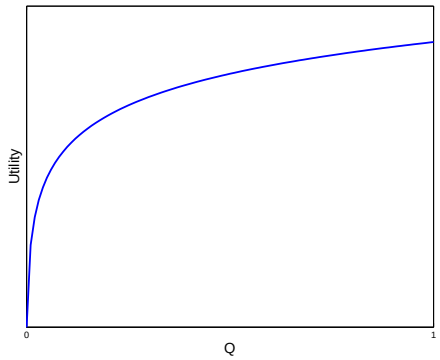
Utility Functions: Describe Consumers' Preferences

Availability



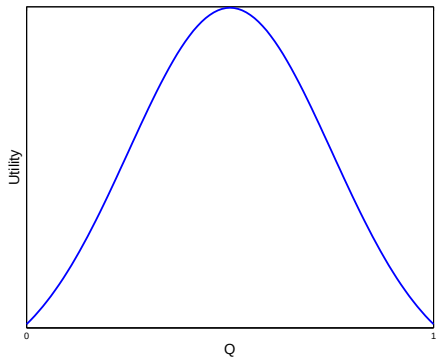
Rapid increase close to desired value

Throughput



Diminishing returns

Throughput of subservice

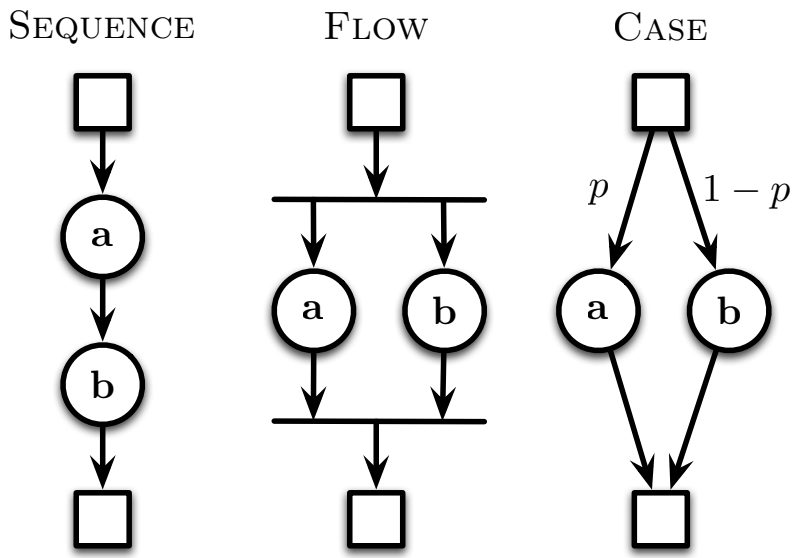


Tradeoff between being idle or buffering heavily

Formalize Composition: Define Composition Operator f

How quality of subservices is composed based on quality and composition type

Quality\Composition	**Sequence**	**Flow**	**Case**
Latency	SUM	MAX	SWITCH
Throughput	MIN	SUM	SWITCH
Failure	PRODUCT	PRODUCT	SWITCH

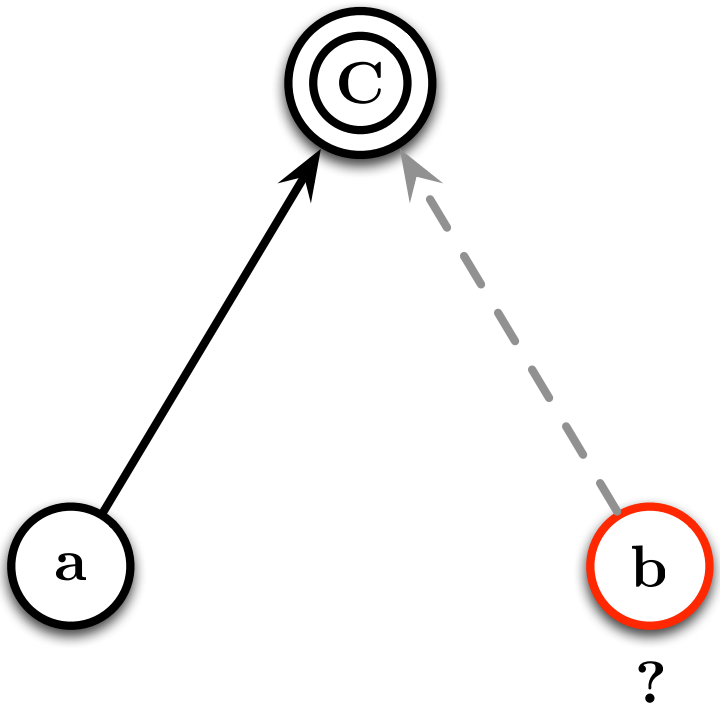


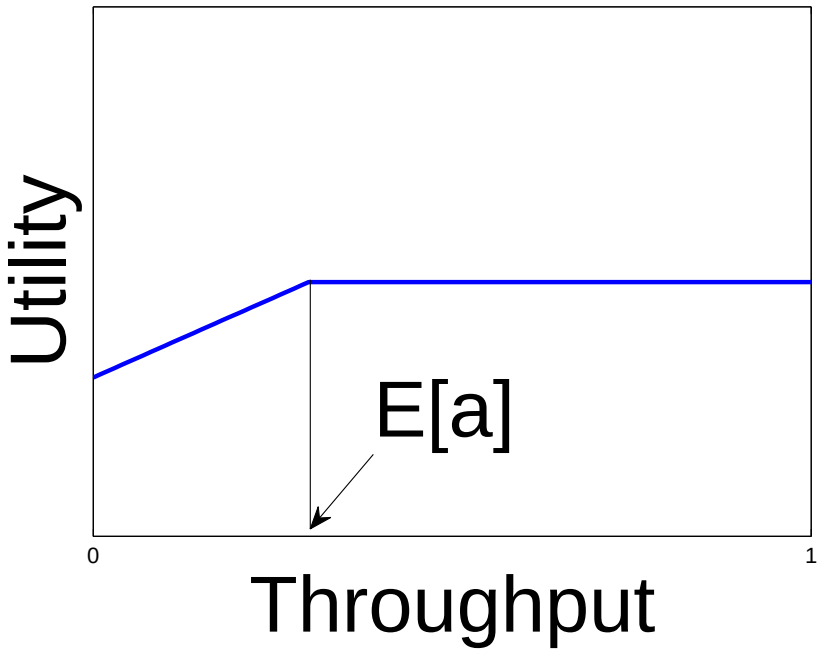
Utility Function for Service Composition

Adjusting utility function

Quality type: *Throughput*
Composition type: **Sequence**
} → Composition operator f: MIN

Expected Quality of **a**: $E[a]$





Exploration versus Exploitation

Learning policy

- Exploitation: Choosing current best choices
  - Stuck in a rut: May yield low long-term utility
    - Lack knowledge of new providers
    - Known providers dynamically change their profiles
- Exploration: Need to learn about unknown providers
  - Curiosity killed the cat: May yield low short-term utility

Boltzmann Exploration: balance exploration and exploitation

- Choose providers that yield higher expected utility more frequently
- Damp down exploration over time

Preliminary Results

Goal: services are used by those who value them most

Experimental Setup

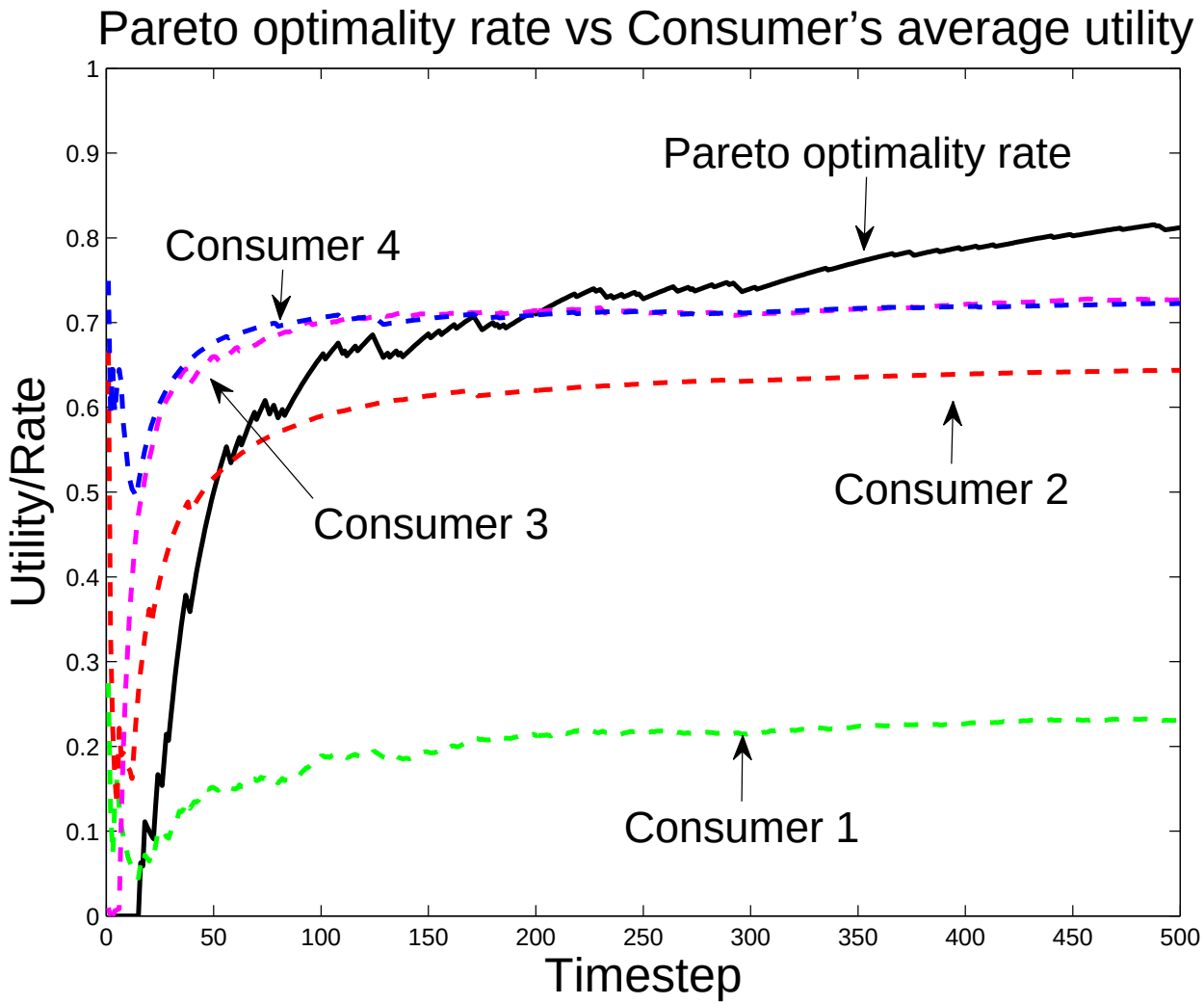
- Four consumers; three providers
- Each provider has a capacity of two concurrent consumers
- Consumers can
  - Explore: interact with and learn about unknown providers
  - Exploit: sign long-term contract with good providers

Evaluation

1. Individual utility gain
2. Efficiency of resource allocation (providers $\mapsto$ consumers)
   - Pareto Optimal Allocation: Cannot alter allocation to help one consumer without hurting another

Preliminary Results

Pareto optimality rate: % of time a Pareto allocation can be found



Outline

Service Ecosystem

Principals (and their services) coexisting in an environment that cooperate and compete to facilitate the production and exchange of value

- Characteristics of services
  - Production of value
  - Autonomy: self-interest
  - Memory and learning
  - Potential for coalitions
  - Adaptivity
- Characteristics of ecosystems
  - Exchange of value
  - Memory and learning
  - Heterogeneity or diversity
    - Yet, potential intersubstitutability
  - Surprising interactions
    - Dynamic structure and membership
    - Ecological niches

Thanks!

http://www.csc.ncsu.edu/faculty/mpsingh/