

## Welcome to SENG 480B / CSC 485B / CSC 586B Self-Adaptive and Self-Managing Systems

Dr. Hausi A. Müller  
Professor  
Department of Computer Science  
University of Victoria

<http://courses.seng.uvic.ca/courses/2013/summer/seng/480b>  
<http://courses.seng.uvic.ca/courses/2013/summer/csc/485b>  
<http://courses.seng.uvic.ca/courses/2013/summer/csc/586b>

## Announcements

- Fri, June 28
  - Midterm in class
  - Prof. Venkatesh Srinivasan will administer the midterm
  - I will grade it ☺
- Midterm format
  - Closed books, closed notes, no phones or gadgets
  - Mostly essay type questions
- Midterm topics
  - Self-adaptive systems
  - Autonomic systems
    - MAPE-K loop
    - ACRA hierarchy
    - Symptoms
    - Policies
  - Feedback systems
    - Positive/negative/hybrid feedback
    - PID controllers
  - ULS systems
    - ULS characteristics
    - Wicked problems

## Assignment 3 Part I — Utility Functions

- In Part I you are to write a tutorial for software engineering or computer science undergraduate students on the role of utility functions and how they are used in autonomic computing policies and SLA agreements.
- To get started by reading the technical report by John Wilkes of HP Labs entitled "Utility functions, prices, and negotiation," 2008.
- The answers for this question should fit into approximately 3-4 typeset pages.

## Assignment 3 Part II — PID Controllers

- In Part II you are to design and simulate a simple PID controller. Moreover, you are to document your experience in the form of a tutorial.
  - Study the PID controllers as discussed in class.
  - Watch the videos posted in the resource section on PID controllers.
  - Define a simple resource control problem.
  - Design a simple PID controller for this resource control problem.
  - Simulate your PID controller using Matlab.
  - Write a tutorial or SE or CS undergrad students on how to build a simple PID controller using Matlab.
- The answers for this question should fit into approximately 3-4 typeset pages.

## Utility functions, prices & negotiation

- Communicating business intent to self-managing systems
- What makes automation easier?
  - a single metric to optimize against
- What do business care about?
  - money!
- What is money a proxy for?
  - Utility → a measure of "goodness"

John Wilkes, HP Labs: Utility functions, prices, and negotiation, HP Tech Report and Slides, 2008.

## SLA as Contracts

- A **Service Level Agreement (SLA)** is a contract
  - between mutually suspicious parties
  - if you care about something, put it in the SLA!
  - agreement can be explicit or implicit
- Assumptions
  - machine readable, can be reasoned about
  - Usually involves two-parties: provider, client

John Wilkes, HP Labs: Utility functions, prices, and negotiation, HP Tech Report and Slides, 2008.

## WS-Agreement Basics

- Context
  - who, why, duration
- Service terms
  - what service is offered, and how it is offered
- Guarantee terms
  - scope and conditions (e.g., time of day)
  - Service Level Objectives (SLOs)
  - penalties and rewards

John Wilkes, HP Labs: Utility functions, prices, and negotiation, HP Tech Report and Slides, 2008.

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## Outcome-based Pricing

- A better way
- Replace all the SLA guarantee terms by a **single price function**
- Specifies how much the service provider is **paid for each possible outcome**
- Omit all details of *how* the outcomes are achieved

John Wilkes, HP Labs: Utility functions, prices, and negotiation, HP Tech Report and Slides, 2008.

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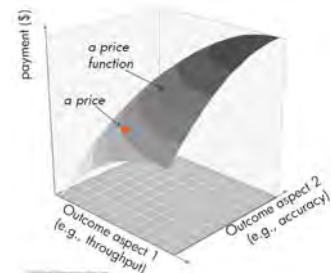
## Outcome-based Pricing



John Wilkes, HP Labs: Utility functions, prices, and negotiation, HP Tech Report and Slides, 2008.

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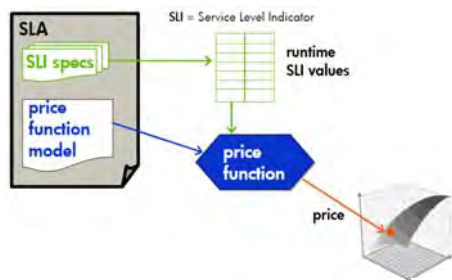
## Outcome-based Pricing



John Wilkes, HP Labs: Utility functions, prices, and negotiation, HP Tech Report and Slides, 2008.

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## Outcome-based Pricing



John Wilkes, HP Labs: Utility functions, prices, and negotiation, HP Tech Report and Slides, 2008.

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## Outcome-based Pricing

- Only one price function in each SLA
  - $function(\text{set of metrics/parameters}) \rightarrow \text{a price}$
- Evaluated by:
  - service provider to determine what to charge
  - client to predict what will happen
  - third party to audit

John Wilkes, HP Labs: Utility functions, prices, and negotiation, HP Tech Report and Slides, 2008.

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## Outcome-based Pricing

- **Benefits**
  - either side can predict price for given outcome
  - can be audited by 3rd party
  - consequences can be explored automatically or simulated
- **Requirements**
  - standalone, deterministic, flexible
  - well-defined, unambiguous, visible inputs
    - SLIs (Service Level Indicators)

John Wilkes, HP Labs: Utility functions, prices, and negotiation, HP Tech Report and Slides, 2008.

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## Outcome-based Pricing

- **Pricing** is the strategy used for setting prices
  - pricing strategy → results in price function
- Competition, price pressures → sets max prices
- Customer utility → limits what customers will pay
  - demand-elasticity curves

John Wilkes, HP Labs: Utility functions, prices, and negotiation, HP Tech Report and Slides, 2008.

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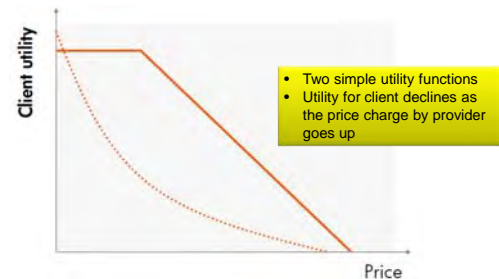
## Utility

- **Utility** = local measure of goodness
  - more is better!
- Arbitrary, local units
  - can be rescaled and re-normalized
  - For example:  $> 0 \rightarrow \text{win}$ ,  $< 0 \rightarrow \text{lose}$

John Wilkes, HP Labs: Utility functions, prices, and negotiation, HP Tech Report and Slides, 2008.

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## Utility for a Fixed Outcome



John Wilkes, HP Labs: Utility functions, prices, and negotiation, HP Tech Report and Slides, 2008.

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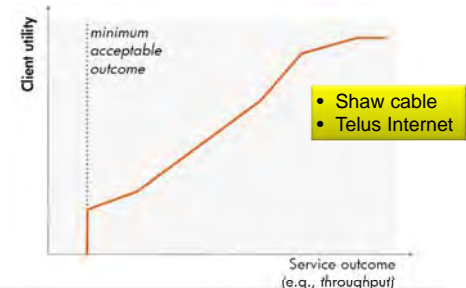
## Utility for a Fixed Outcome



John Wilkes, HP Labs: Utility functions, prices, and negotiation, HP Tech Report and Slides, 2008.

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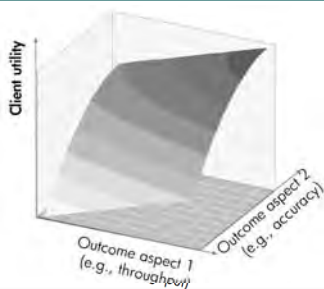
## Utility for a Variable Outcome



John Wilkes, HP Labs: Utility functions, prices, and negotiation, HP Tech Report and Slides, 2008.

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## Client Utility for two Outcomes



John Wilkes, HP Labs: Utility functions, prices, and negotiation, HP Tech Report and Slides, 2008.

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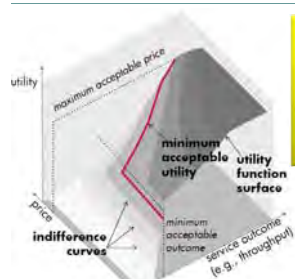
## Indifference curves and surfaces

- The client is said to be *indifferent* to (i.e., equally happy with) all outcomes that produce the same value of utility
- The curve connecting such a set of points is called an *indifference curve*.

John Wilkes, HP Labs: Utility functions, prices, and negotiation, HP Tech Report and Slides, 2008.

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## Combining Outcomes and Price



- Utility as a function of service throughput and price
- With indifference curves on the surface representing the function

John Wilkes, HP Labs: Utility functions, prices, and negotiation, HP Tech Report and Slides, 2008.

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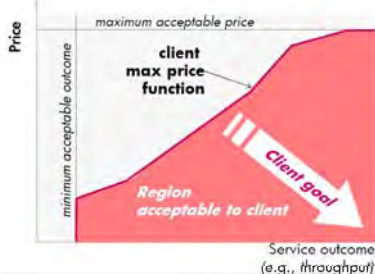
## Minimal Acceptable Utility



John Wilkes, HP Labs: Utility functions, prices, and negotiation, HP Tech Report and Slides, 2008.

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## Client Utility



John Wilkes, HP Labs: Utility functions, prices, and negotiation, HP Tech Report and Slides, 2008.

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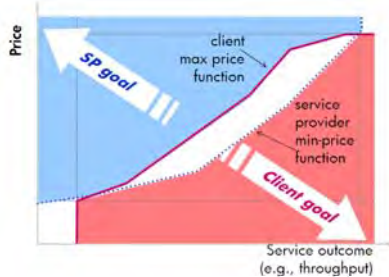
## Service Provider Utility



John Wilkes, HP Labs: Utility functions, prices, and negotiation, HP Tech Report and Slides, 2008.

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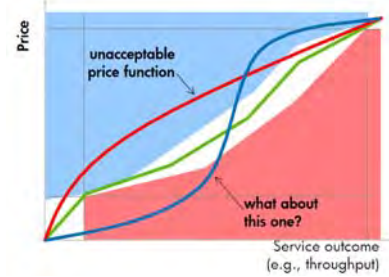
## Room for Negotiation



John Wilkes, HP Labs: Utility functions, prices, and negotiation, HP Tech Report and Slides, 2008.

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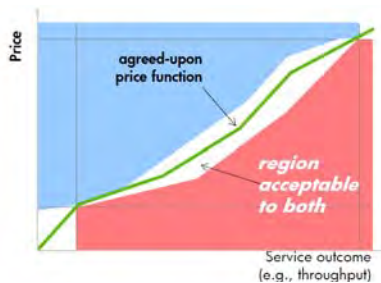
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## Negotiated Price Function



John Wilkes, HP Labs: Utility functions, prices, and negotiation, HP Tech Report and Slides, 2008.

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## Negotiation Considerations

- Success → SLA; failure → no SLA
  - there's a utility aspect to reaching an agreement
- Support each party's interests
  - maximize achievable utility
- Purely rational agents
  - not people!

John Wilkes, HP Labs: Utility functions, prices, and negotiation, HP Tech Report and Slides, 2008.

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## Negotiation Considerations

- **Fairness** is entirely optional ...
  - self-interested parties
  - but: people will walk away from a deal they consider unfair, even if they would benefit from it
- Approaches
  - note: cannot do "equal utility"
  - *k-pricing*: split the profit/loss difference
  - → requires trusted 3<sup>rd</sup> party

John Wilkes, HP Labs: Utility functions, prices, and negotiation, HP Tech Report and Slides, 2008.

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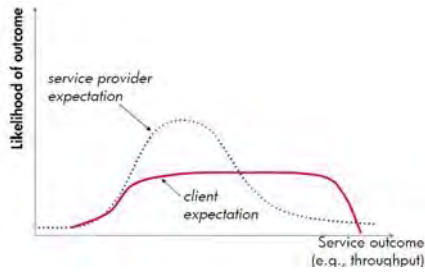
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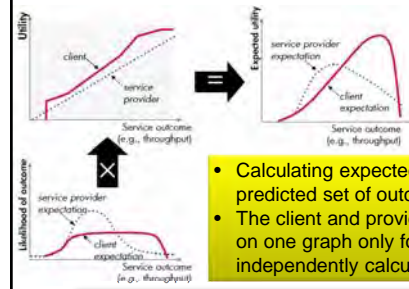
## Variance in Outcome: Expected Utility



John Wilkes, HP Labs: Utility functions, prices, and negotiation, HP Tech Report and Slides, 2008.

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## Variance in Outcome: Expected Utility



- Calculating expected utility for a predicted set of outcome likelihoods.
- The client and provider lines are shown on one graph only for convenience; independently calculated.

John Wilkes, HP Labs: Utility functions, prices, and negotiation, HP Tech Report and Slides, 2008.

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## Variance in Outcome: Risk

- Variance in outcome = risk
- Examples:
  - component failure → poor availability
  - lack of resources → poor performance
- What-if prices:
  - outcome variance → price variance

John Wilkes, HP Labs: Utility functions, prices, and negotiation, HP Tech Report and Slides, 2008.

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## Variance in Outcome: Penalties

- Purpose
  - be bad for the victim
  - punitive vs. compensatory?
  - caution: a bad outcome that can be triggered by another party
- Pricing for penalties
  - estimate expected outcomes
  - add profit margin
  - add risk aversion (cf. insurance)

John Wilkes, HP Labs: Utility functions, prices, and negotiation, HP Tech Report and Slides, 2008.

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## Shaw/Telus Customer Service

Pratik Jain and Nina Taheri Makhsos

- SLA : Provide better service based on response time. Late response larger penalty.
- Business and Home customers.
- Utility function defining efficient use of resources and generate high profit.

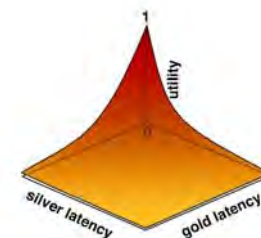
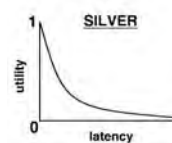
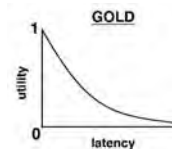
GOAL: SLA service response time 12 hours.

Response Time	Penalty for Business customers		Penalty for Home customers	
	Contract	Monthly	Contract	Monthly
5 days	1	0.8	0.6	0.4
3 days	0.8	0.6	0.5	0.3
1 days	0.2	0.1	0.3	0.2

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## Server Latency

Gareth Johnson and Ali Alsaihanty





# Help Desk SLA

Pauline Redding and David Clarke

## Service Level Agreement - IT Helpdesk

David Clarke, Pauline Redding

**Goal:**

- Provide support to users within a target time.

**Utility Function:**

- criteria -> response time

Priority	Criteria	Response Time
1	Affects more than five individuals, or a mission critical and there is no workaround available.	Will call or page technicians for immediate response
2	Affects one to five individuals, no workaround available.	Initial response within 5 working hours.
3	Affects fewer than five people, workarounds available.	Initial response within three working days.
	Affects one individual, or unsupported software.	Best effort as time allows.

**Rationale for the UF:**

- The utility function provides a required response time given an issue's specific criteria.

References: <http://helpdesk.gartner.com/doc/916101/it-service-level-agreement>

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# Wind Speed Warning System

Andi Bergen and Carlos Gomez

## WindSpeed

Customer	Platinum	Gold	Silver
11-13	1	0.7	0.5
8-10	1	0.9	0.3
5-7	0.7	0.9	1
1-4	0.1	0.5	1

SLA: warn customers within reasonable time of wind-speeds which are dangerous for their operations.

Platinum = big airports ... Gold = Little Airports ... Silver = Marinas

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