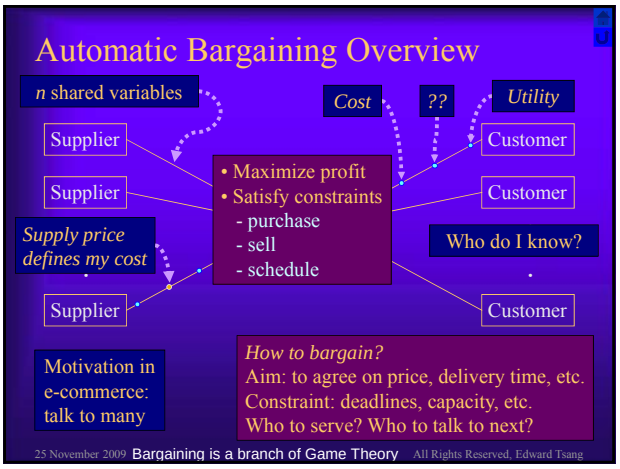
Automatic Bargaining Overview
n shared variables
Cost
??
Utility
Supplier
Supplier
Supplier
Customer
Customer
Customer
• Maximize profit
• Satisfy constraints
- purchase
- sell
- schedule
Supply price defines my cost
Who do I know?
Motivation in e-commerce: talk to many
How to bargain?
Aim: to agree on price, delivery time, etc.
Constraint: deadlines, capacity, etc.
Who to serve? Who to talk to next?
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Bargaining is a branch of Game Theory
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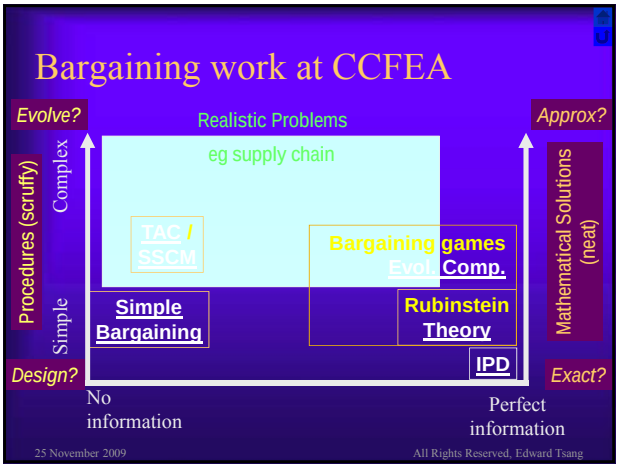
Bargaining work at CCFEA
Evolve?
Realistic Problems
Approx?
eg supply chain
Procedures (scruffy)
Complex
Simple
Mathematical Solutions (neat)
TAC / SSCM
Bargaining games
Evol. Comp.
Simple Bargaining
Rubinstein Theory
IPD
Design?
Exact?
No information
Perfect information
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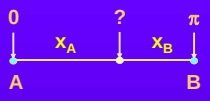
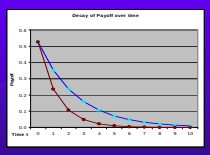
Bargaining Theory
Abhinay Muthoo
http://www.essex.ac.uk/economics/people/staff/muthoo.shtm

Bargaining in Game Theory

- Rubinstein Model:

In reality:
Offer at time $t = f(r_A, r_B, t)$
Is it necessary?
Is it rational? (What *is* rational?)





- A's payoff x_A drops as time goes by
  A's Payoff = $x_A \exp(-r_A t\Delta)$
- Important Assumptions:
  - Both players rational
  - Both players know *everything*
- Equilibrium solution for A:
  $\mu_A = (1 - \delta_B) / (1 - \delta_A\delta_B)$
  where $\delta_i = \exp(-r_i \Delta)$

Optimal offer:
$x_A = \mu_A$
at t=0

Notice:
No time *t* here

Bargaining is a branch of Game Theory

- Game theory is a mathematical framework
  - A set of methods and tools
  - For studying strategic situations
- Bargaining games constitute the best/classic class of games
  - It involves conflicts (we both want a bigger share)
  - It need cooperation (we both need a deal asap)
- Repeated Games is another big class of games

Terminology in bargaining theory

- Optimal – doing what is best for oneself
  - In bargaining, what is best for me depends on what the other player does
- Subgame – now and at any point in the future
- Subgame Perfect Equilibrium (SPE)
  - Each player deploys a strategy that is best for her at each and every subgame
  - Optimal strategy by both players

Iterative Prisoner's Dilemma

Axelrod's experiments
Tit-for-tat

Prisoner's Dilemma

Payoffs		Player A: Cooperate	Player A: Defect
Player B	Co-operate	1 / 1	0 / 4
	Defect	4 / 0	2 / 2

- What's the optimal decision for A (or B)?
- What if this game is repeated?

Iterated Prisoner's Dilemma (IPD)

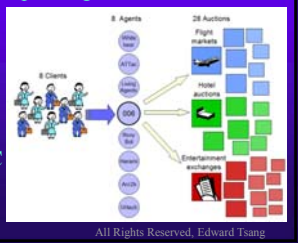
- Axelrod organized two tournaments in 1980
  - Round one: 14 entries
  - Round two: 62 entries from 6 countries
- Tit-for-Tat was the winner in both runs
  - Start by cooperation
  - Then follow whatever the opponent did last round
- GRIM is an alternative local optimum
  - Like Tit-for-Tat, except being unforgiving

Trading Agents Competition for E-Commerce

Maria Fasli
http://cswww.essex.ac.uk/staff/mfasli

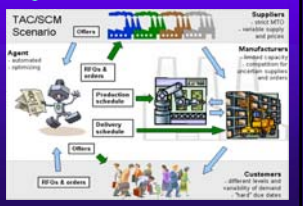
Trading Agents Competition (TAC)

- Classic Game (*Thalis*)
  - Simultaneous auctions with substitutable and interrelated goods
  - Dynamic bid configuration depending on historical data, current state and projected state
  - Application of *Strategic Demand Reduction*
  - Domain-specific heuristics
  - 3rd and 4th positions in TAC 2003 and 2004 respectively

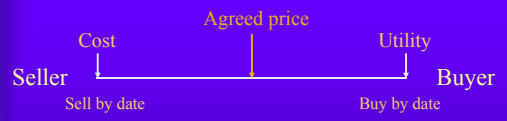


TAC Work at Essex

- Supply Chain Management Game (*Socrates*)
  - An agent acts as a reverse auctioneer with the suppliers in multi-attribute auctions with substitutable and interrelated goods. Suppliers use a reputation mechanism and their delivery may be partial or complete
  - Dynamic scheduling for production and delivery
  - Ordering strategy and factory utilisation are interdependent and crucial
  - ICEC-03: 7th position



Local Constraint Optimisation



- Every agent is self-centred
- Agents constrain each other
- The simplest form of local constraint satisfaction / optimisation above
  - All deeper research depends on strategy in this problem

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Game Theory Hall of Frame

1994 Nobel Prize


John Harsanyi


John Nash


Reinhard Selten

2005 Nobel Prize


Robert Aumann


Thomas Schelling

1994 Nobel Economic Prize Winners


John Harsanyi (Berkeley)
Incomplete information


John Forbes Nash (Princeton)
Non-cooperative games


Reinhard Selten (Bonn)
Bounded rationality (after Herbert Simon)
Experimental economics

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1978 Nobel Economic Prize Winner

- Artificial intelligence
- "For his pioneering research into the decision-making process within economic organizations"
- *"The social sciences, I thought, needed the same kind of rigor and the same mathematical underpinnings that had made the "hard" sciences so brilliantly successful."*
- Bounded Rationality
  - *A Behavioral model of Rational Choice 1957*

Herbert Simon (CMU)

Artificial intelligence

Sources: http://nobelprize.org/economics/laureates/1978/ http://nobelprize.org/economics/laureates/1978/simon-autobio.html

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2005 Nobel Economic Prizes Winners

- Robert J. Aumann, and Thomas C. Schelling won 2005's Noel memorial prize in economic sciences
- For having enhanced our understanding of conflict and cooperation through game-theory analysis

Robert J. Aumann 75

Thomas C. Schelling 84

Source: http://www.msnbc.msn.com/id/9649575/ Updated: 2:49 p.m. ET Oct. 10, 2005

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Robert J. Aumann

Winner of 2005 Nobel Economic Prize

- Born 1930
- Hebrew Univ of Jerusalem & US National Academy of Sciences
- "Producer of Game Theory" (Schelling)
- Repeated games
- Defined "*Correlated Equilibrium*"
  - Uncertainty not random
  - But depend on info on opponent
- Common knowledge

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Thomas C. Schelling

Winner of 2005 Nobel Economic Prize

- Born 1921
- University of Maryland
- "User of Game Theory" (Schelling)
- Book "The Strategy of Conflict" 1960
  - Bargaining theory and strategic behavior
- "Book Arms and Influence" 1966
  - foreign affairs, national security, nuclear strategy, ...
- Paper "Dynamic models of segregation" 1971
  - Small preference to one's neighbour → segregation

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