Collective Intelligence

- In theory: cooperation, competition, and coordination produce some emergent super-individual capabilities that transcend those of the individual

- In practice (currently): crowdsourcing, folksonomies, social computation, human-based computation

- Emergence: “you throw the pieces of a watch on a table and suddenly, there’s a watch!”

- Tempting: “emergent macro-scale phenomena will do our work for us”. But how do you design for intelligence to emerge? (And what do you do when it does?)
Agents

- Ambiguous, overused, overhyped term - let’s just assume it means something like “AI with an integration focus”

- Single-agent systems: integration of capabilities in one embodied, situated entity operating on behalf of a user

- Multiagent systems: integration of several agents (esp with different goals) in the same environment

- The “different goals” bit is the genuinely new element
Petascale data processing is the name of the game today, massive application benefits.

Data is not “intelligent” in itself, it is human interpretation that makes it useful.

Analysing data relies on human expert, this part often not explicit in systems design.

Effectively, the intelligent agents in the “data-driven” world of computing are still human experts.
Design

- Human (and machine) intelligence as reflected in data says nothing about what to do with it
- Describing purposeful computation and aiding it with automated support is missing
- Top-down perspective of specification and reasoning vs. bottom-up perspective of data-driven computation
- Agents provide right technology for this, but largely disconnected from “data world”
Incentives

- The missing link between data and behaviour toward it – the key to design for collective intelligence
- Economics based models currently offer the only rigorous framework (game theory etc)
- These models don’t account for many types of human behaviour (esp. in constantly changing Web world)
- Agents: modelling systems with potential conflict of interest, simulating human behaviour
Semantics

- Meaning = Cognition + Incentive
  - Human intelligence of individuals interprets information with a purpose, and produces knowledge
  - Evolution of collective intelligence mediated by configuration of different participants’ incentives and interpretations
  - Emergent collective knowledge reflected in evolution of semantics of symbols used
  - “Evolving Symbol Systems Hypothesis”: Incentive-aware rules for manipulating semantics sufficient to achieve collective intelligence
Challenges

- Multi-level modelling and evolution of representations, linking “deep” to “shallow” reasoning
- Reasoning about incentives and behaviour, but engaging with humans to learn about these
- Lack of automation support for users and application designers: tapping into new data is useful, but not enough
(My own) Examples

- Computing solutions to interaction problems from high-level problem specifications
- Mining opponent and context models from executions of agent interaction protocols
- Collaborative and competitive methods for distributed machine learning
- Developing executable declarative languages for implementing social reasoning in agents