14:00–15:45 Session 1

14:00 Nicolas Vieille - Invited talk
Detecting deception: Implementation in Markovian environments

14:50 Frédéric Meunier: The uniqueness property for networks with several origin-destination pairs.

We consider congestion games on networks with nonatomic users and user-specific costs. We are interested in the uniqueness property defined by Milchtaich as the uniqueness of equilibrium flows for all assignments of strictly increasing cost functions. He settled the case with two-terminal networks. As a corollary of his result, it is possible to prove that some other networks have the uniqueness property as well by adding common fictitious origin and destination. In the present work, we find a necessary condition for networks with several origin-destination pairs to have the uniqueness property in terms of excluded minors or subgraphs. As a key result, we characterize completely bidirectional rings for which the uniqueness property holds: it holds precisely for nine networks and those obtained from them by elementary operations. For other bidirectional rings, we exhibit affine cost functions yielding to two distinct equilibrium flows. Related results are also proven. For instance, we characterize networks having the uniqueness property for any choice of origin-destination pairs. Joint work with Thomas Pradeau.

15:20 Yannick Viossat: Every compact nonempty semi algebraic set is the set of equilibrium payoffs of the first k players in some finite game

It is well known that the set of equilibrium payoffs of any finite game with N players is a nonempty, compact and semi-algebraic subset of \( \mathbb{R}^N \). By Tarski-Seidenberg’s theorem, this implies that any projection of such a set on a subspace \( \mathbb{R}^k \), \( k < N \) satisfies the same properties. We establish a converse to this fact: for any nonempty, compact and semialgebraic subset \( E \) of \( \mathbb{R}^k \), we prove that there exists some finite game with \( N \) players, \( N > k \) and 2 actions per players such that \( E \) is precisely the set of equilibrium payoffs of the first \( k \) players in this game. The proof is constructive. Joint work with Guillaume Vigeral.

15:45–16:15 ......................... Coffee Break ...........................
16:15–17:55 **Session 2**

**Chair:** Nicolas Vieille

16:15 **Olga Gorelkina: Target bidding and collusion in Vickrey auctions**

We describe a new way to preclude prior information exchange and bidder collusion in the Vickrey (second-price) auction of a single indivisible good. At the prior stage, a bidding ring can form to designate the highest-valuation bidder to win the auction, and to enforce monetary transfers from that bidder to other members of the ring. The modification of the auction rules incites deviations from the designated-winner scenario and thus undermines collusion through information exchange before the auction. The construction of mechanism does not require the knowledge of colluders’ identities or distributions of valuations, in which sense it is entirely detail-free.

16:40 **Marco Scarsini: Dynamic atomic congestion games with seasonal flows**

We propose a model of discrete time dynamic congestion games with atomic players and a single source-destination pair. The latencies of edges are composed by free-flow transit times and possible queuing time due to capacity constraints. We give a precise description of the dynamics induced by the individual strategies of players and of the corresponding costs, either when the traffic is controlled by a planner, or when players act selfishly. Importantly, we model seasonalities by assuming that departure flows fluctuate periodically over time. Our main contributions are two-fold. First, we introduce a measure that captures the queues induced by periodicity of inflows. For socially optimal flows, this measure is the increase in costs compared to uniform departures. The same holds for equilibrium flows, if the network is parallel. In general the analysis is more intricate. We even provide an example in which periodic departures induce lower equilibrium costs than the uniform departures. Second, we illustrate a new dynamic version of Braess’s paradox: the presence of initial queues in a network may decrease the long-run costs in equilibrium. This paradox may arise even in networks for which no Braess’s paradox was previously known.

17:05 **Eduardo Perez: Evidence based matching**

We consider implementation of different matching functions with evidence. We show that any stable matching is implementable with evidence under sufficiently rich evidence structures if types are only about preferences or only about characteristics. If types include both characteristics and preferences, then the acyclicity condition needed for straightforward implementation may fail. We also show that, the matching produced by the top trading cycle algorithms, which is not stable, creates cycles.
Olivier Tercieux: *The design of teacher assignment: Theory and evidence*

In several countries, teachers’ assignment to schools is managed by a central administration. One of the objectives of this reassignment process is to make sure that teachers obtain an assignment which they weakly prefer to their current position. The Deferred-Acceptance mechanism (DA) proposed by Gale and Shapley (1962) fails to satisfy this constraint. As a solution, a variation on this mechanism has been proposed in the literature and used in practice - as for the assignment of French teachers to schools. In this paper, we show that this mechanism yields assignments that can be improved in terms of both efficiency and fairness. For each of the two efficiency notions considered in the literature (two-sided or one-sided), we identify the class of mechanisms which cannot be improved upon in terms of efficiency and fairness. Additionally, for two-sided efficiency, we show that a unique mechanism in the associated class is strategy-proof. For one-sided efficiency, no mechanism in the class is strategy-proof. Finally, using a rich dataset on teachers’ applications to transfer in France, we empirically assess the extent of potential efficiency and fairness gains associated with the adoption of our mechanisms. These empirical results confirm the poor performance of (the variation on) the DA mechanism, and the significant improvement brought by our proposed mechanisms in terms of both efficiency and fairness. Joint work with Julien Combe (PSE), and Camille Terrier (PSE & LSE).
9:00–10:20 **Session 3**

**09:00 Redouan Bshary** - *Invited talk*

*A game theoretic approach to study marine cleaning mutualism*

Cooperation between unrelated individuals has attracted a lot of research as mutual helping behaviours have to be reconciled with evolutionary theory and its emphasis on egoism. A standard interdisciplinary approach is to use (evolutionary) game theory in order to identify strategies and corresponding partner control mechanisms that promote stable cooperation. We have used and advanced such models to better understand marine cleaning mutualism involving the cleaner wrasse *Labroides dimidiatus*. In this mutualism, so called ‘client’ reef fish visit the cleaners to have ectoparasites removed. Conflict of interest occurs as cleaner prefer the protective client mucus over ectoparasites, where eating the former constitutes cheating. The way that clients resolve this conflict of interest in their favour depends on their strategic options, leading to the threat of reciprocity, punishment, partner switching, early termination of interactions as well as attributing social prestige to cleaners: I will present data that show how we test for such partner control mechanisms and end with various recent extensions.

**09:55 Minus van Baalen:** *Biological information: What is it and can we quantify it?*

Information plays a critically important role in ecology and evolution but is very often subjective or analog or both. This is a problem because most information theory has been developed for objective and discrete information. Can information theory be extended this theory to incorporate multiple forms of information, each with its own (physical) carriers and dynamics? Here I will not review all the possible roles information can play, but rather what conditions an appropriate theory should satisfy.

10:20–10:50 ......................... Coffee Break .........................

10:50–12:30 **Session 4**

**10:50 Jeanne Hagenbach:** *Communication with evidence in the lab*

We study communication with evidence in a sequence of sender-receiver games in the lab. The theory suggests important differences between games with cyclic and acyclic masquerade relations. We find that receivers take evidence into account and perform better in acyclic games and with more precise messages. In acyclic games, they tend to be skeptic about vague messages, and over time learn to be more skeptic following partial disclosure. Senders fully disclose in all games when they are of a narcissistic types, and tend to use vague messages when their type is envious. When using partial disclosure, they are prone to systematic mistakes in all games.
11:15 Stefan Behringer: *Optimal harvesting of renewable resources on the unit circle*

We survey recent work on optimal harvesting of renewable natural resources. While in most standard approaches the resource is located at a single point, Behringer & Upmann (2014) allow the resource to be distributed spatially. Consequently, an agent who exploits the resource has to travel from one location to another. For a fixed planning horizon the speed and the path of harvesting chosen by the agent is investigated when harvesting takes place on locations that can be topologically mapped onto a unit circle. It is shown that the agent adjusts this speed so as to visit each location only once, even in the absence of travelling cost. Since the agent does not return to any location for a second harvest, it is optimal to fully deplete the resource upon arrival. A similar type of bang-bang solution results when the assumption of a constant harvesting rate is relaxed: allowing for a variable harvesting rate, the agent chooses to fully exploit the resource either in the last or in the first travelling period. A society interested in conserving some of the resource thus has to take measures to limit the exploitative behaviour of the agent. The model is then extended to accommodate endogenous prices and realistic transport data.

11:40 Xavier Venel: *Stochastic games with partial observation and Borel evaluation*

The aim of this presentation is to study two-player zero-sum stochastic games with partial observation. At each stage, both players choose some actions. This generates a stage payoff then a new state and new signals are randomly chosen according to a transition function. There are several ways to study the long term behaviour of these games. A lot of attention has been given to two of these approaches: the asymptotic behavior of the $n$-stage game and the uniform value which focuses on what payoff a player can guarantee independently of the length of the game. A recent counterexample of Ziliotto (2013) with symmetric information showed that when the players are not informed of the state, the values of the $n$-stage games may not converge. In this presentation, we come back to a point of view coming from the literature of game determinacy (Gale and Stewart 1953) and adopted by Maitra and Sudderth (1992): from the sequence of stage payoff, we can define an evaluation on the set of infinite histories and study the existence of the value in the induced normal form game. We provide several counterexamples to the existence of the value and several positive results. In particular, there exists a value for any Borelian evaluation in stochastic games with symmetric information.

12:05 Miquel Oliu Barton: *The limit game approach for stochastic games*

12:30–14:00 ........................................ Lunch .................................
14:00–15:45 Session 5

14:00 Silvio Micali - Invited talk
Resilient mechanism design

14:55 Laurent Gourves: Cake cutting and matroids

We are interested in the fair allocation of indivisible goods and its extension to matroids. In particular, we are interested in the determination of worst case lower bounds on the utility of the poorest agent. These bounds are obtained via a protocol, inspired of the famous "cut and choose".

15:20 Nicolas Markey: Temporal logics for multi-player games

Temporal logics are a powerful formalism for expressing properties of computerized systems. They have been widely used in model checking, a model-based technique for automatically verifying properties of such systems. When dealing with complex distributed systems, game models can be used to represent the interactions between several components. Temporal logics then need to be extended to express what the components can achieve. In this talk, I will introduce those temporal logics and survey the main results that have been obtained.

15:45–16:15 Coffee Break

16:15–17:30 Session 6

16:15 Sidartha Gordon: Information choice and diversity: The role of strategic complementarities

We study a class of games where players face restrictions on how much information they can obtain on a common payoff relevant state, but have some leeway in covertly choosing the dependence between their signals, before simultaneously choosing actions. Using a new stochastic dependence ordering between signals, we show that each player chooses information that is more dependent on the information of other players whose actions are either isotonic and complements with his actions or antitonic and substitutes with his actions. Similarly, each player chooses information that is less dependent on the information of other players whose actions are antitonic and complements with his actions or isotonic and substitutes with his actions. We then provide sufficient conditions for information structures such as "public information" or "private information" to arise in equilibrium. Equilibrium information structures may be inefficient. Making which signals were chosen (but not their realizations) publicly observable may restore efficiency. Joint work with Catherine Gendron-Saulnier.

16:40 Christina Pawlovitsch: Extensive-form rationalizability, invariance, and forward induction

17:05 Philippe Bich: Existence of generalized Nash equilibria in games with incomplete preferences
9:00–10:20 Session 7

09:00 Sebastian Van Strien - Invited talk
Fictitious games

In this talk I will discuss some remarkable properties of continuous fictitious games (i.e. best response dynamics). My talk will concentrate on two issues:

(i) a comparison of the payoff that players receive with the payoff had they played Nash equilibrium, and

(ii) a surprising relationship of zero-sum games with Hamiltonian systems (physical systems without friction) and some ramifications this may have for a conjecture of Hofbauer.

09:55 Pierre Cardaliaguet: The convergence problem in mean field games

Mean Field Games theory allows to model the dynamics of large number of agents. In this setting, it has been conjectured that the limit of Nash equilibria for differential games as the number of players tends to infinity can be described by the so-called master equation. In this joint work with François Delarue, we show that the master equation is well-posed and is indeed the limit of Nash equilibria

10:20–10:50 ......................... Coffee Break ...............................
10:50–12:30 Session 8  Chair: Jeanne Hagenbach

10:50 Lucie Ménager: Observation delays in teams

We study a dynamic team problem à la Bonatti and Hörner (2010) in which two players continuously contribute to a common project whose reward is uncertain. The probability that the project is successful increases with the level of effort made by the two players. We introduce delay in this model by assuming that players are informed of the success or the failure of their partner with a time lag $\Delta$. This delay is interpreted as a technological constraint on information transmission. We find that, contrary to case without delay in which payoffs and efforts are constant at the symmetric equilibrium, the equilibrium payoff follows a regular cyclical pattern and the strategies are bang bang. Also, there exists a asymmetric equilibrium if and only if $\Delta$ is sufficiently small.

11:15 Thomas Mariotti: Researcher’s dilemma

We model academic competition as a game in which researchers fight for priority. Researchers privately experience breakthroughs and decide how long to let their ideas mature before making them public, thereby establishing priority. In a two-researcher, symmetric environment, the resulting preemption game has a unique equilibrium. We study how the shape of the breakthrough distribution affects equilibrium maturation delays. Making researchers better at discovering new ideas or at developing them has contrasted effects on the quality of research outputs. Finally, when researchers have different innovative abilities, speed of discovery and maturation of ideas are positively correlated in equilibrium.

11:40 Frederic Koessler: Informed seller with heterogeneous consumers

We study how a seller optimally sell his good to a buyer whose willingness to pay depends on his privately-known taste and on product characteristics privately known by the seller. The optimum is characterized by a mediated selling protocol and is sometimes implementable by bilateral face-to-face cheap talk after which the seller asks a price conditional on the conversation. Posted prices without cheap talk are suboptimal. The seller benefits ex-ante from private information and never benefits from committing to a disclosure rule. Ex-ante revenue-maximizing mechanisms are equilibria of this informed seller game and coincide with core mechanisms. This informed principal game is extended to the case in which the seller's information is (partially) certifiable.

12:05 Joseph Abdou: On power distributions and stability of political mechanisms

We study the structure of unstable power mechanisms. A power mechanism is modeled by an interaction form, the solution of which is called a settlement. By stability, we mean the existence of some settlement for any preference profile. Configurations that produce instability are called cycles. We introduce a stability index that measures the difficulty of emergence of cycles. We apply our analysis to strategic game forms in the context of Nash-like solutions or core-like solutions. In particular, we establish an upper bound on the stability index of maximal interaction forms. We carry out full calculations for lattice game forms.

12:30–14:00 Lunch
14:00–15:45 **Session 9**

**Chair:** Wiesław Zielonka

**14:00** Tomáš Brázdil - *Invited talk*

*Patrolling games*

Patrolling games are partially observable games played by two players, the defender and the attacker. The defender aims for detecting intrusions into vulnerable targets by following randomized routes among them, the attacker strives to maximize the probability of a successful (undetected) intrusion. After introduction of patrolling in general, I will concentrate on adversarial patrolling games played on oriented graphs where the attacker is assumed to know the strategy of the defender. Such games make a foundation for computing optimal patrolling strategies in adversarial domains such as the United States Federal Air Marshals Service and the United States Coast Guard. I will show that in these games the defender has always an optimal strategy which, however, may require both memory and randomization, and may (inevitably) employ irrational probabilities. I will discuss structure of optimal strategies for various special cases of patrolling games and finally present an algorithm for computing epsilon-optimal strategies.

**14:55 Sophie Pinchinat: **Uniform Strategies**

We investigate uniformity properties of strategies of extensive infinite games. These properties involve sets of plays in order to express useful constraints on strategies that are not regular. Typically, we can state that a strategy is observation-based. We propose a formal language to specify uniformity properties, interpreted over two-player turn-based arenas equipped with a binary relation between plays. This way, we capture e.g. games with winning conditions expressible in epistemic temporal logic, whose underlying equivalence relation between plays reflects the observational capabilities of agents (for example, synchronous perfect recall). Our framework naturally generalizes many other situations from the literature.

**15:20 Rida Laraki: **Inertial game dynamics and applications to constrained optimization**

Aiming to provide a new class of game dynamics with good long-term rationality properties, we derive a second-order inertial system that builds on the widely studied “heavy ball with friction” optimization method. By exploiting a well-known link between the replicator dynamics and the Shahshahani geometry on the space of mixed strategies, the dynamics are stated in a Riemannian geometric framework where trajectories are accelerated by the players’ unilateral payoff gradients and they slow down near Nash equilibria. Surprisingly (and in stark contrast to another second-order variant of the replicator dynamics), the inertial replicator dynamics are not well-posed; on the other hand, it is possible to obtain a well-posed system by endowing the mixed strategy space with a different HR metric structure and we characterize those HR geometries that do so. In the single-agent version of the dynamics (corresponding to constrained optimization over simplex-like objects), we show that regular maximum points of smooth functions attract all nearby solution orbits with low initial speed. More generally, we establish an inertial variant of the so-called “folk theorem” of evolutionary game theory and we show that strict equilibria are attracting in asymmetric (multi-population) games – provided of course that the dynamics are well-posed. A similar asymptotic stability result is obtained for ESS in symmetric (single-population) games. Joint work with Panayotis Mertikopoulos.
Session 10

Chair: Joseph Abdou

16:40 Catherine Rainer: A probabilistic representation for continuous-time games with incomplete information on both sides.

In the framework of repeated games with asymmetric information as well as for continuous time games with incomplete information on one side, it is well known that the value of the game has a probabilistic interpretation in terms of a game (resp. control-) problem, where the actions of the players are martingales. We show that result also holds for continuous time games with lack of information on both sides. In our case these martingales are continuous and can be expressed as stochastic integrals with respect to two Brownian motions.

17:05 Said Hamadene: On the value of a zero-sum switching game

We deal with the solutions of systems of PDEs with bilateral inter-connected obstacles of min-max and max-min types. These systems arise naturally in stochastic switching zero-sum game problems. We show that when the switching costs of one side are regular, the solutions of the min-max and max-min systems coincide. Furthermore, this solution is identified as the value function of a zero-sum switching game. Switching problems get involved especially in the energy market.

17:30 Marie Amelie Morlais: ε-Nash equilibrium of a multi-player nonzero-sum Dynkin game in discrete time

We present an infinite horizon discrete time $N$-player nonzero-sum Dynkin game ($N \geq 2$) with stopping times as strategies (or pure strategies). The payoff processes of the players are general and depend on the coalition in the agreement to stop the game. Once explained the modelization of the problem, we prove the existence of an $\epsilon$-Nash equilibrium point for the game consisting of an $N$ tuple of optimal random times. Such an equilibrium is reached if and only if the payoff for each player satisfies the assumption that she (the player) gains more when she is not involved in the agreement to stop than when she is. Since the existence of the $\epsilon$-Nash equilibrium is based on an explicit construction of $N$ sequences of random dates we shall provide a detailed proof of this algorithm.
We explore evolutionary dynamics in repeated games, with and without discounting, with and without complexity costs, and with and without population structure. In absence of complexity costs and population structure, the dynamics are driven by indirect invasions. Indirect invasions are stepping stone paths out of equilibrium, where neutral mutants open doors for subsequent mutants, that have a selective advantage only after the neutral mutant establishes itself through drift. Populations playing repeated prisoners dilemmas then typically wander from one equilibrium to the other through series of indirect invasions. Complexity costs and population structure allow for more complex behaviour, but also here indirect invasions are essential to understanding the dynamics.

Tom Lenaerts: To apologize or not to apologize ; the evolutionary viability of forgiveness in interrupted commitments in the iterated prisoners dilemma

When starting a new collaborative endeavor, it pays to establish upfront how strongly your partner or partners plan to commit to the common goal and what compensation can be expected in case the collaboration is violated. Diverse examples in biological and social contexts have demonstrated the pervasiveness of making prior agreements on posterior compensations, suggesting that this behavior could have been shaped by natural selection. We showed that when the cost of arranging a commitment deal lies within certain limits, substantial levels of cooperation are attainable [1,2]. Recently we were also able to show that behaviors like revenge, apology and forgiveness can evolve when long-term commitments fail the Iterated Prisoners Dilemma [3]. The main conclusion from this work is that for apologies to work they need to be sufficiently costly. References:


[ 3 ] Luis A. Martinez-Vaquero, The Anh Han, Luís Moniz Pereira and Tom Lenaerts (2015) To err is human, to forgive evolutionary viable when the apology is sincere. Scientific Reports (to appear)
10:50–12:30 **Session 12**

**Chair:** Philippe Bich

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**10:50 Chantal Marlats: Costly observation in bandit problems**

We analyse a bandit model in which players face a trade-off between exploration (i.e. generating information) and exploration (using information). We depart from the existing literature by assuming that players can observe each other only if they pay a cost. We characterize the symmetric Markovian equilibrium and show its uniqueness. It turns out that costly observation modifies strategic behaviors in a non-trivial way. In terms of equilibrium payoffs, the priori effects are ambiguous. On the one hand, players have to pay a cost in order to get information, which have direct negative impact. But this reduces free riding. So on the other hand, costly observation has a positive effect on the payoffs since the opponent generates more information. We show that in the the first effect dominates the second one.

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**11:15 Endre Csóka: Efficient teamwork**

We model multi-agent projects where each agent has a private workflow including hidden actions and chance events, which can influence each other through publicly observable actions and events. We design an efficient and prior-independent mechanism for this novel environment which is quasi-dominant strategy incentive-compatible, collusion-resistant, individually rational and avoids free-riders.

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**11:40 Nizar Allouch: Policy reform in networks: the interbank liquidity game**

This paper investigates the interbank liquidity game, where banks may access their direct neighbours’ liquidity holdings. We investigate the optimal direction of policy reform and characterise both welfare winners and welfare losers. More specifically, we use a geometric approach to characterise two general cases - where the welfare improvement is accompanied by a Pareto improvement, and when it is not. In this regard, our spectral analysis of policy reform leads to a full characterisation of the welfare impact of taxation.

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**12:05 Sebastien Cochinard: Some fixed point and fixed set properties of solution correspondences in coalitional TU games**

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12:30–14:00 ......................... Lunch ...............................

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14:00–15:45 **Session 13**

**Chair:** Françoise Forges

**14:00** Philippe Jehiel - *Invited talk*

*Categorization and investment strategy: An equilibrium perspective*

Categorizations are formed according to the similarities observed in some cues and they are then used to make predictions about other attributes that can be used for decision making. I apply this general principle to the study of investment strategy in which investors base their investment decision on the observed profitability of projects considered similar (with respect to the cue) and in which there was investment, thereby leading to an equilibrium description of the investment strategy. I compare the obtained investment strategy to the Bayesian one that would arise from the same observation of the cue and a complete knowledge of the joint distribution of signals/cues and projects, thereby highlighting the pro-investment bias that the categorization heuristic induces. I also compare the relative performance of using different forms of categorizations (different cues), thereby highlighting that there is no analog of Blackwell’s partial order in this setting. I also analyze the effect such heuristics may have on trade by considering that those projects put in the market are endogenously chosen by strategic agents.

**14:55** Panayotis Mertikopoulos: *Learning in concave games*

Most of the literature on game-theoretic learning has focused on expected utility maximization in games with a finite number of players and a finite number of actions per player. While relatively tractable, such games are ill-suited to practical applications where players pick an action from a continuous action space (such as Cournot competition models or delay minimization in data traffic networks). In this talk, we focus on games with convex action spaces and concave payoffs, and we introduce a unilateral learning algorithm based on mirror descent optimization methods. Under Rosen’s strict diagonal concavity condition (a sufficient condition for equilibrium uniqueness), we show that this algorithm converges to Nash equilibrium almost surely, even in the presence of observation noise and asynchronous/delayed updates. Otherwise, when the game admits multiple Nash equilibria, we provide a set of sufficient conditions which guarantee that the algorithm converges to the game’s Nash set with high probability.

**15:20** Mael Le Treust: *Empirical coordination for imperfect monitoring structure*

We investigate the problem of coordination between two agents that choose some actions and imperfectly observe the actions of the other agent. This problem is related to a point-to-point communication model in which an encoder and a decoder choose their symbols/actions (i.e. channel input and decoder output) in order to transmit information and to coordinate themselves. Encoder and decoder implement a coding scheme such that the empirical frequency of symbols are close to a target joint probability distribution. This approach, based on information theory, has promising repercussions for future decentralized networks and for repeated game with imperfect monitoring. The feasible trade-offs between transmissions and coordinations are characterized using joint probability distributions over symbols of source and channel. We determine optimal trade-offs between transmission and coordination by maximizing a utility function over the set of achievable probability distributions.

15:45–16:15 ................................. Coffee Break .................................
16:15–17:30 **Session 14**  
Chair: Mael Le Treust

**16:15 Maia King: Who can you trust? Reputation and cooperation in networks**

Community enforcement is an important device for sustaining efficiency in some repeated games of cooperation. We investigate community enforcement when information about players’ reputations spreads through a fixed information network to their future partners. We find an endogenous cooperation network which lists the potentially cooperative relationships for a given information network, and examine some characteristics of network structures and network positions that are most - and least - amenable to community enforcement. Using a new centrality measure, we link a player’s network position, payoffs and trust.

**16:40 Erik Martin-Dorel: Formal proofs and certified computation in Coq**

Formal methods provide a set of mathematical techniques, designed to specify and verify the behavior of computer systems, regarding software as well as hardware. These methods are typically used in areas where errors can cause loss of life or significant financial damage. In this talk, I will focus on formal proof techniques, especially around the Coq tool, which is developed by Inria. I will present its main features as well as the various approaches that are possible when using such a formal tool. Then I will give an overview of the main libraries available in Coq, especially those related to real analysis, or whose use contributes to facilitate the formalization and verification of results in game theory, or more generally in mathematics. If time permits, I will illustrate my point by presenting the CoqInterval library, which offers decision procedures to automatically prove inequalities about real-valued univariate expressions.

**17:05 Laurent Doyen: Synthesis from probabilistic components**

The synthesis problem asks for the automatic construction of a system from its specification. In the traditional setting, the system is constructed from scratch rather than composed from reusable components. However, this is rare in practice, and almost every non-trivial software system relies heavily on the use of libraries of reusable components. We consider probabilistic components, as a model of component reliability. The synthesis problem from a library of probabilistic components is to construct a system that satisfies its specification with probability 1, using the components of the library, that is to construct a reliable system from unreliable components.

We present improved complexity bounds for the synthesis problem from probabilistic components by a reduction to a game problem on graphs, and we show that the more general quantitative problem (that asks the specification be satisfied with a given probability) is undecidable.
Let us allow the players of a one-shot Bayesian non-cooperative game to agree on a committed joint decision after having exchanged information through cheap talk. Simple examples show that, even if one player is uninformed and does not care for the other -informed - player’s action (generalized sender-receiver game), no jointly agreed decision may be achievable. Sufficient conditions are given for the existence of allocations that can be implemented by means of (perfect Bayesian) equilibria involving cheap talk and unanimous approval. A crucial use is made of results that were originally established for repeated games with incomplete information by S. Sorin (1983), R. Simon, S. Spiez and H. Torunczyk (1995) and J. Renault (2000). The approach is thus similar to the one of Aumann and Hart (2003), who show how repeated games can be used to analyze the effects of cheap talk before the non-cooperative play of a Bayesian game. Joint work with Ulrich Horst and Antoine Salomon.

We introduce finite games with the following types of players:

(I) nonatomic players,
(II) atomic splittable players,
(III) atomic non splittable players.

We recall and compare the basic properties, expressed through variational inequalities, concerning equilibria, potential games and dissipative games, as well as dynamics. Then we consider composite games, a typical example being congestion games, and extend the previous properties of equilibria and dynamics. Finally we describe an instance of composite potential game. Joint work with Cheng Wan (Oxford).
10:50–12:30 **Session 16**

**Chair:** Vianney Perchet

**10:50** Yukio Koriyama: *The Condorcet Jury Theorem under cognitive hierarchies: theory and experiments*

We introduce an endogenous cognitive hierarchy model in which players hold heterogeneous beliefs on the other players’ cognitive levels. Each player is assumed to best-reply holding a belief induced by the cognitive hierarchy. Contrary to the previous models, however, players are allowed to consider the presence of opponents at their own level of cognitive hierarchy. This extension is shown to eradicate the incompatibility of standard cognitive hierarchy models in the games where the best reply function is an expansion mapping. We employ the model to explain voting behavior in information aggregation problems of the Condorcet Jury Theorem. Behavioral assumption of the strategic thinking turns out to be a crucial factor in whether the asymptotic efficiency is obtained or not. We conducted laboratory experiments and obtained the evidence that the endogenous cognitive hierarchy model provides significant improvements upon symmetric Bayesian Nash equilibrium and the standard cognitive hierarchy models in explaining the observed behavior of voters.

**11:15** Stefano Moretti: *Ranking players in an ordinal coalitional framework*

Power indices have been widely used in the literature of cooperative games to assess the influence of single players in a setting where coalitions are winning or losing. On the other hand, many practical situations are characterized by coalitions (e.g. representing alliances of political parties, or federations of States, or football teams, etc.) that are ordered according to their strength, and where the notion of winning and losing groups does not apply. Nevertheless, comparing the ability of individuals to influence the relative strength of coalitions is an interesting issue in these situations too. To that end, we axiomatically study new notions of ordinal power associating to each coalitional power relation (i.e. a total preorder over the set of all possible subsets of players) a ranking of the players based on their ability to form strong alliances in the society.

**11:40** Fabien Gensbittel: *Zero-sum stopping games with asymmetric information*

We study a model of two-player, zero-sum, stopping games with asymmetric information. We assume that the payoff depends on two continuous-time Markov chains \((X, Y)\), where \(X\) is only observed by player 1 and \(Y\) only by player 2, implying that the players have access to stopping times with respect to different filtrations. We show the existence of a value in mixed stopping times and provide a variational characterization for the value as a function of the initial distribution of the Markov chains. We also prove a verification theorem for optimal stopping rules in the case where only one player has information. (preprint:http://arxiv.org/abs/1412.1412)
Gilles Stoltz: Approachability in unknown games: Online learning meets multi-objective optimization

In the standard setting of approachability there are two players and a target set. The players play a repeated vector-valued game where one of them wants to have the average vector-valued payoff converge to the target set which the other player tries to exclude. We revisit the classical setting and consider the setting where the player has a preference relation between target sets: she wishes to approach the smallest ('best') set possible given the observed average payoffs in hindsight. Moreover, as opposed to previous works on approachability, and in the spirit of online learning, we do not assume that there is a known game structure with actions for two players. Rather, the player receives an arbitrary vector-valued reward vector at every round. We show that it is impossible, in general, to approach the best target set in hindsight. We further propose a concrete strategy that approaches a non-trivial relaxation of the best-in-hindsight given the actual rewards. Our approach does not require projection onto a target set and amounts to switching between scalar regret minimization algorithms that are performed in episodes.

Joint work with Shie Mannor (Technion) and Vianney Perchet (Univ. Paris Diderot & INRIA).

12:30–12:35 ……………………………. Closing …………………………….
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