Mathematical Computer Science
People

• **Permanent staff:**
  – Peter Bro Miltersen, Professor
  – Kristoffer Arnsfelt Hansen, Associate Professor
  – Gudmund Skovbjerg Frandsen, AC-TAP
  – Dorthe Haagen Nielsen, Research Group Coordinator

• **Postdocs:**
  – Wei Yu
  – Jie Zhang
  – Joshua Brody
  – Dominik Scheder
  – Kevin Matulef

• **PhD students:**
  – Rasmus Ibsen-Jensen
  – Simina Branzei
  – Navid Talebanfard
  – Aris Filos-Ratsikas
  – Søren Kristoffer Stiil Frederiksen
Projects

• CFEM, center for research in the foundations of electronic markets, 2010-2016
  
  [cfem.dk]
  
  THE ELECTRONIC MARKETS OF THE FUTURE

• CTIC, center for the theory of interactive computation, 2011-2014
Topics

• Computational complexity theory
• Combinatorial optimization
• Algorithms for Satisfiability
• Game theory
• Mechanism design
• Multiagent systems
• Real algebraic geometry
Truthful approximations to range voting

Aris Filos-Ratsikas
Peter Bro Miltersen
Social welfares:
\[ w(A) = u_1(A) + u_2(A) = 1.73 \]
\[ w(B) = u_1(B) + u_2(B) = 0.00 \]
\[ w(C) = u_1(C) + u_2(C) = 1.61 \]

Range voting: Elect candidate maximizing social welfare

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Range voting is not **truthful** (truthful reporting is not a dominant strategy)
Challenge of mechanism design

• Design multiagent algorithms so that it is a dominant strategy for agents to behave as algorithm suggests.

• In case of voting, we want in addition to approximate optimal social welfare as good as possible.
RANDOM-FAVORITE, a trivial algorithm

- Pick random voter and output his favorite candidate
- This has approximation ratio 0.5
Approximation ratios for three candidates

<table>
<thead>
<tr>
<th>Type of mechanism</th>
<th>Lower bound</th>
<th>Upper bound</th>
</tr>
</thead>
<tbody>
<tr>
<td>Ordinal and Mixed-unilateral</td>
<td>0.610</td>
<td>0.611</td>
</tr>
<tr>
<td>Ordinal</td>
<td>0.616</td>
<td>0.641</td>
</tr>
<tr>
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<td>0.660</td>
<td>0.750</td>
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Mechanisms work for all $n$

Upper bounds work for sufficiently large $n$, except last one which only works for $n=3$
Results for $m=3$

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With probability 0.29, do RANDOM-FAVORITE.

With probability 0.71, pick random voter and let $z$ be the valuation of his middle candidate.

- Elect his top candidate with probability $\frac{1-2z+z^2}{6}$
- Elect his middle candidate with probability $\frac{1+2z}{6}$
- Elect his bottom candidate with probability $\frac{4-z^2}{6}$.
THANK YOU AND HAVE A WONDERFUL SUMMER !!!!