

Summer School Course, Istanbul Technical University, 31st Jul – 3rd Aug 2007

Hyper-heuristic Research in ASAP Group **Course Introduction**

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Hyper-heuristics – Course Introduction

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Course Schedule

- Part I (Day 1): Introduction
- Part II (Days 2 & 3): Hyper-heuristic Research
 - Constructive and improvement hyper-heuristics
 - Different themes in hyper-heuristics
- Part III (Day 4)
 - Summary



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Course Schedule

- Day 1 (31st July 2007)
 - Lecture 1: Outline of the course & Introduction to meta-heuristics
 - Lecture 2: Meta-heuristics
 - Lecture 3: Overview of application domains
 - Lecture 4: Introduction to hyper-heuristics



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Course Schedule

- Day 2 (1st August 2007)
 - Lecture 1: Constructive Hyper-Heuristics 1
 - Lecture 2: Constructive Hyper-Heuristics 2

 - Lecture 3: Improvement Hyper-Heuristics 1
 - Lecture 4: Improvement Hyper-Heuristics 2



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Course Schedule

- Day 3 (2nd August 2007)
 - Lecture 1: Constructive Hyper-Heuristics 3
 - Lecture 2: Improvement Hyper-Heuristics 3

 - Lecture 3: Multi-Objective Hyper-Heuristics
 - Lecture 4: Genetic Programming as a Hyper-Heuristics



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Course Schedule

- [Day 4](#) (3rd August 2007)
 - Lecture 1: Search Space Analysis of Hyper-heuristics
 - Lecture 2: Summary, and Research Directions



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A Brief Introduction to Search

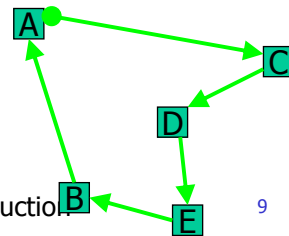


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Search Space

- The concept of search plays an important role in science and engineering
- Often we can't simply write down and solve the equations for a problem
- In one way, any problem whatsoever can be seen as a search for “the right answer”

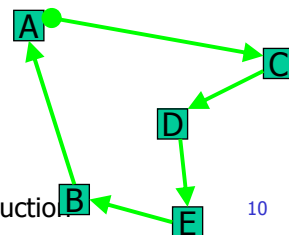


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Search Space

- Search space (state space)
- Goal state
- Moving operator
- Neighborhoods



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Search Space

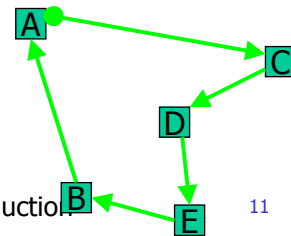
- Solving the TSP means finding the minimum cost solution
 - Given a set of cities and distances between them
 - Then find the optimal tour, that is, the shortest possible such tour

– $n!$ $n=50$ $1.52 * 10^{64}$

- **Combinatorial explosion!**



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Heuristics and Meta-heuristics

- Heuristics
 - Rule of thumb
 - Methods towards finding optimal solutions
 - Piece of advice that is usually based on prior experience
 - A technique which improves the efficiency of a search process, possibly by sacrificing claims of completeness



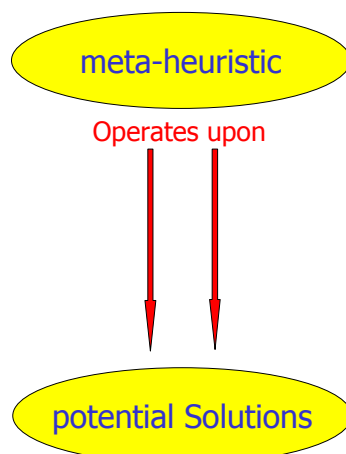
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Heuristics and Meta-heuristics

- Meta-heuristics
 - Heuristics with mechanisms (parameters) for solving computational problems
 - Genetic Algorithms, Tabu Search, Simulated Annealing, Ant Colony, etc

Heuristics and Meta-heuristics



References

- UK Research Council Funding 'Next Generation Decision Support: Automating the Heuristic Design Process" (EP/D061571/1) £2M
- [BUR03] E.K.Burke, G. Kendall, J.Newall, E.Hart, P.Ross & S.Schulenburg, "Hyper-Heuristics: An Emerging Direction in Modern Search Technology", Handbook of Metaheuristics (eds. F.Glover & G.Kochenberger), pp 457 – 474, Kluwer, 2003
- [ROS05] P.Ross, "Hyper-heuristics", Search Methodologies: Introductory Tutorials in Optimization and Decision Support Techniques (eds. E.K.Burke & G.Kendall), pp 529-556, Springer 2005