

Artificial Intelligence Design Challenge at the 1987 Guidance, Navigation, and Control Conference

Monterey, California
August 17-19, 1987

THE engineering application of artificial intelligence technology is at once an exciting but elusive prospect. To stimulate interest in a common problem and enable assessment of different approaches, a design challenge has been formulated. The design challenge results will be the focus of a session at the 1987 AIAA Guidance, Navigation, and Control Conference. The challenge problem is a modification of the well-known traveling salesman problem, and is representative of a class of problems for intelligent GN&C systems operating in an environment of high complexity, uncertainty, and constraints.

To facilitate contest judging, all submissions must include self-contained codes that will execute on an IBM PC under DOS, on an Apple Macintosh, or on other desktop microcomputer systems by prior arrangement. Any programming language may be used, and only executable codes will be exercised at the contest judging. Participation in the contest and the session requires submission of a floppy disk with an executable code by **January 30, 1987**, and submission of an accompanying conference paper by **February 28, 1987**. Submissions, questions, and requests for an entry kit detailing the interface required for judging should be directed to the address given below.

The contest problem statement is:

1) There is a list of 11 cities with a value for each city and a table of intercity airline coach fares. The value for each city is credited to the salesman only if he visits that city.

2) There is an additional cost of \$100 in miscellaneous expenses per city included in the tour, not including the home city at which the tour starts and ends. Nominally, the home city is Detroit.

3) There is an expense budget for the tour of \$3000.

4) The objective is to construct a tour consisting of the ordered list of cities that will maximize the total valuation of those cities that are visited while remaining within the budget constraint. For tours with the same value, the tour with the least travel expense is considered superior. It is not necessary to visit all 11 cities. A city's value is accrued only on the first visit to that city.

5) There is uncertainty in the transportation costs in that there is a 30% chance at each transit that the salesman will

have to pay a 40% first-class premium to obtain a seat on the airplane.

6) The global constraint is that the planned tour must exhibit at least a 0.95 probability of not exceeding the budget limit.

7) One additional local constraints is that the valuation for visiting Los Angeles is lost unless Boston is included at some later position in the tour. This is one example of many local constraints that may appear in such problems.

It is well known that many techniques can be tuned for peak performance on a particular set of problem data. In order to compare different submissions on a common basis, and to assess robustness of performance with respect to different problem data, the submissions will be required to execute the solution for contest evaluation with the following data read from an ASCII file at the time of judging, immediately prior to execution:

- 1) Home city definition
- 2) Global constraint probability and budget limit
- 3) First-class probability and cost multiplier
- 4) City valuations
- 5) Intercity airline coach fares.

The values given in the problem statement and tables are illustrative, with only the total number of cities remaining fixed.

Also, because performance may be a function of computation time, all submissions will be constrained to an execution time equivalent to 20 minutes execution on an IBM PC (8086) computer without coprocessor. Solutions will be judged by an independent evaluation that the constraints are satisfied and will be rank-ordered by total city value over a range of problem variations. In the event of ties, computation time and travel expense will be used as secondary criteria for judging.

Please direct all entries and questions to:

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Intercity Airline Coach Fares

From:	ATL	BOS	CHI	DFW	DEN	DTT	LAX	MSP	MSY	PHX	SEA
To:											
ATL	—	320	220	250	330	220	600	310	150	420	550
BOS	270	—	290	410	460	230	780	310	360	580	620
CHI	190	250	—	230	260	100	640	130	240	380	450
DFW	220	490	270	—	200	330	400	250	150	250	430
DEN	390	550	300	230	—	370	290	240	300	190	340
DTT	190	200	120	280	310	—	600	170	270	440	490
LAX	500	320	270	340	250	510	—	290	430	140	270
MSP	260	370	140	290	210	200	340	—	290	340	370
MSY	170	430	280	170	350	310	520	340	—	410	630
PHX	490	690	450	300	220	520	150	410	350	—	360
SEA	660	750	530	520	280	590	320	440	530	310	—

City Valuations

City Value	ATL	BOS	CHI	DFW	DEN	DTT	LAX	MSP	MSY	PHX	SEA
	6	10	16	8	6	10	20	6	6	6	6