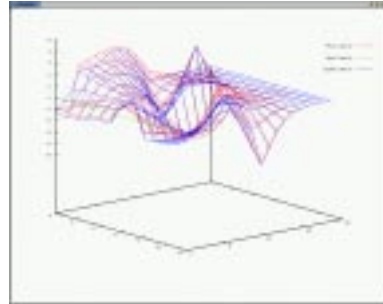


Knowledge Discovery in Awari Endgame Databases

695 Data Mining Project

Anita Petrinjak and Darse Billings



Introduction: Awari

- Awari – ancient African game



Introduction: Awari

- 4000 year old pit and pebble game
- Computers play Awari **much** better than humans
- Very fast search (Mpps, Bppm, 27-ply)
- Evaluation function is still very crude

Introduction: Awari



Softwari

- Roel van der Goot
- Applet: web.cs.ualberta.ca/~games/



U of A wins the silver medal in London

Awari Endgame Databases

- Endgame databases are **BIG** (Chinook)
- Awari endgame DBs are **REALLY BIG**
- Provides an oracle of perfect knowledge, but nothing explicit about *general strategy*

Awari Endgame Database

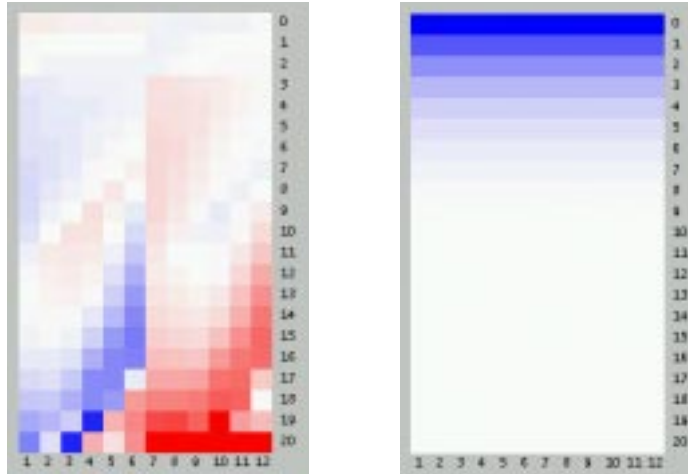


Thomas Lincke's Endgame Applet

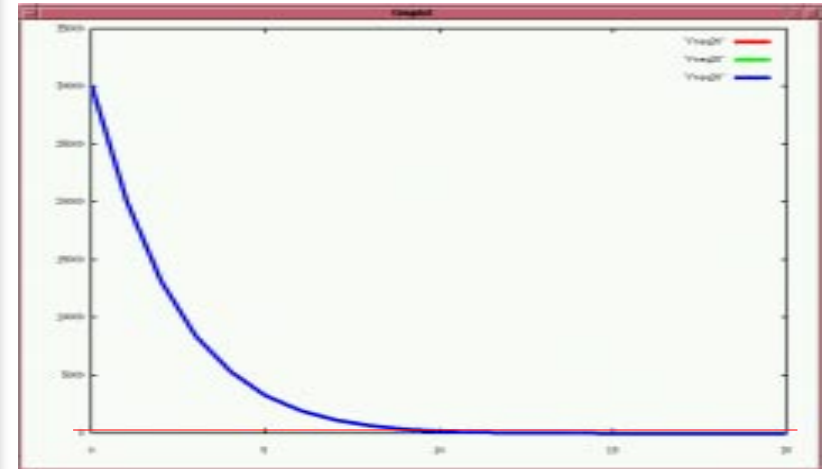
Knowledge Discovery

- Incorporating human knowledge in a game playing program is always tough, but we *don't even have* good domain knowledge for Awari
- Project Goals:
 - extract knowledge that can be used to construct a good evaluation function
 - add to human knowledge about Awari

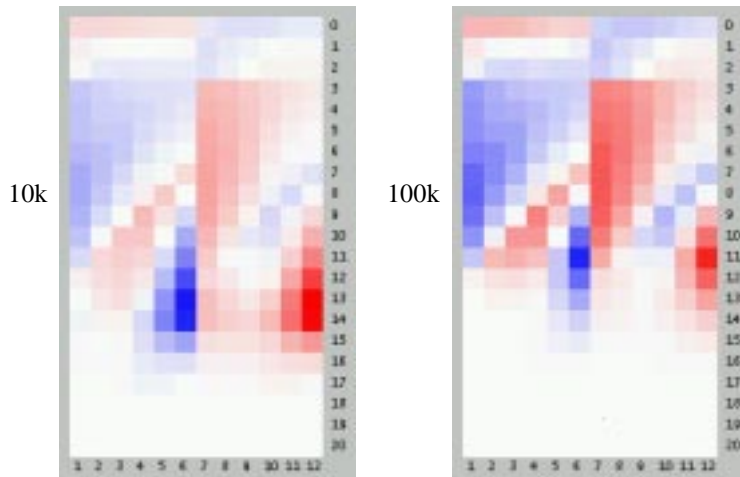
EV visualization and frequency



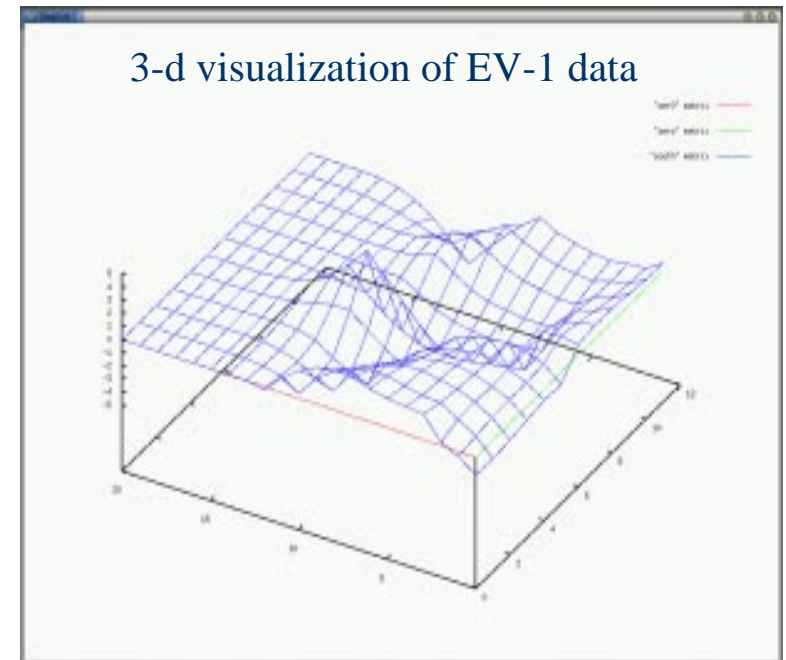
Frequency vs. number of pebbles

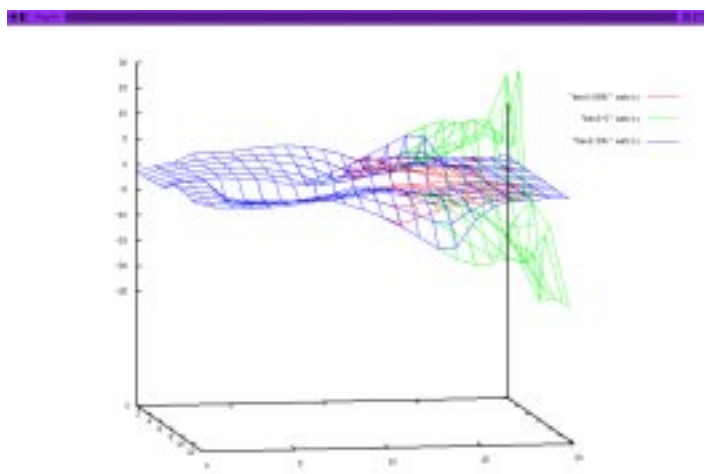
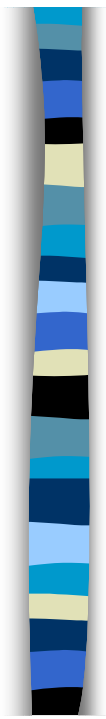


Minimum frequency (Bayesian)

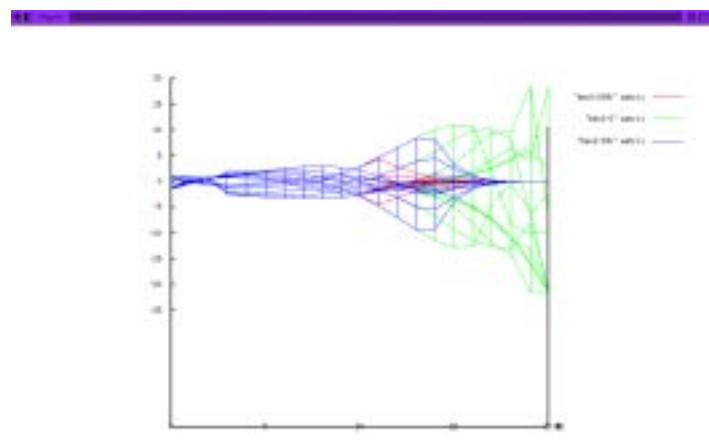
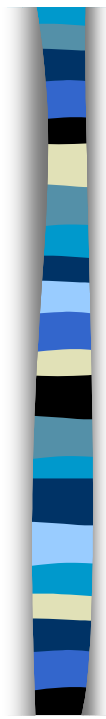


3-d visualization of EV-1 data

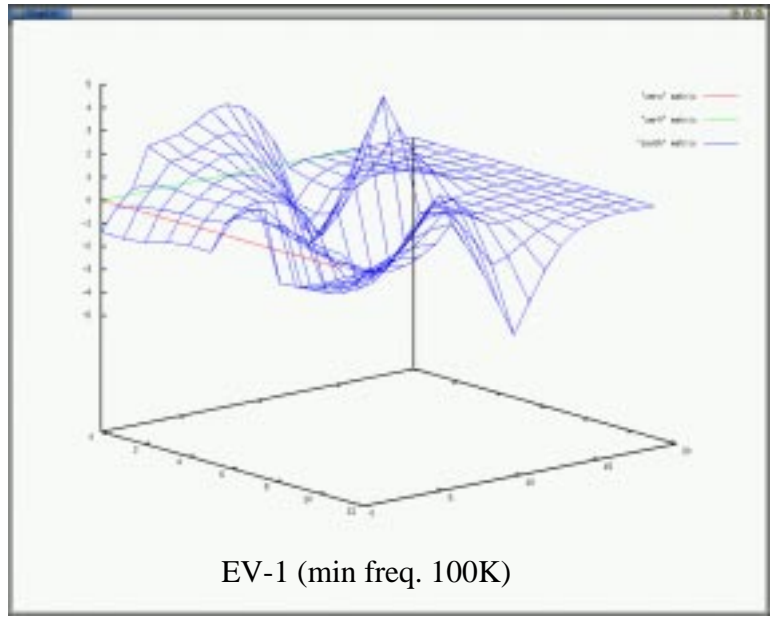




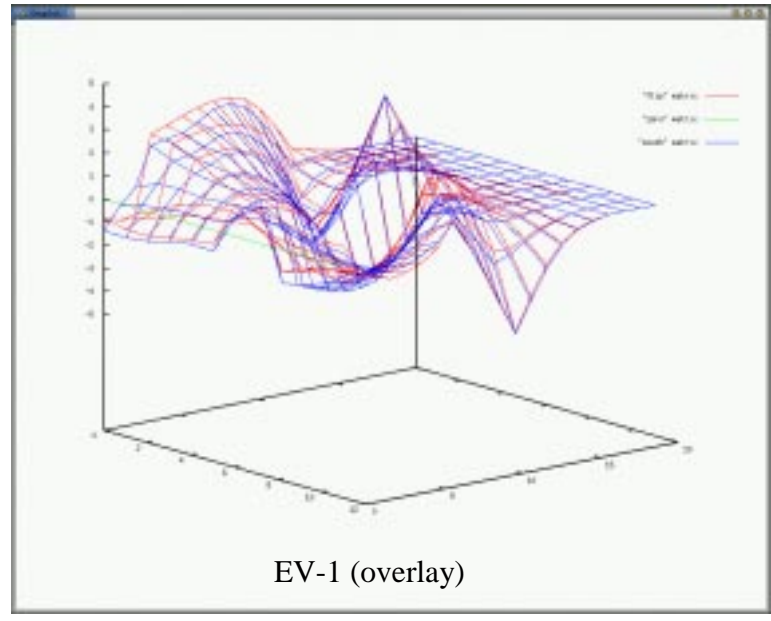
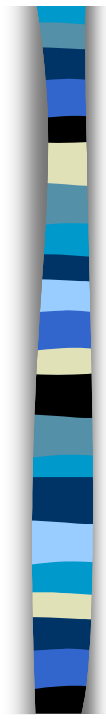
Minimum frequency effect



Minimum frequency effect

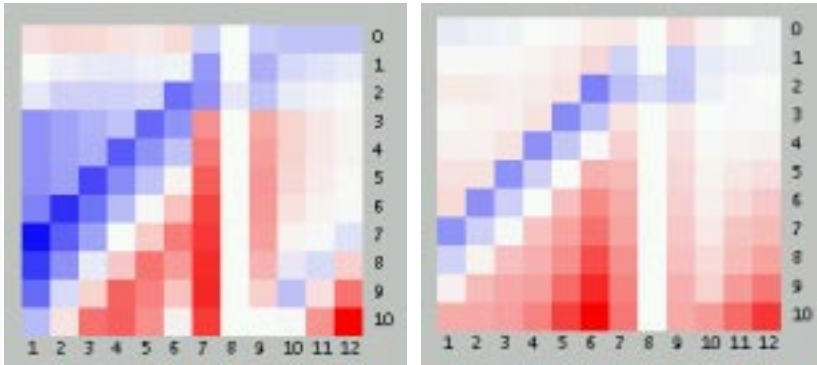


EV-1 (min freq. 100K)



EV-1 (overlay)

EV-2 data: pit_b = 2 pebbles



Raw data

EV-1 difference

Evaluation Function Results

result	frequency	1000
lose	64694821	334
draw	22897612	118
win	105944287	547
sum	193536720	1000
net	293523543	+1.52

eval-2	lose	draw	win	sum
lose	237	33	37	308
draw	37	20	32	90
win	59	63	477	600
sum	334	118	547	1000

mobility			
Correct:	553		Score: 387
Mean squared error:	25.14		

adjusted mobility			
Correct:	576		Score: 415
Mean squared error:	22.84		

eval-1			
Correct:	723		Score: 617
Mean squared error:	13.84		

eval-2			
Correct:	736		Score: 639
Mean squared error:	12.61		

Future Work

- Self-play games:
 - eval vs eval
 - eval vs database (count errors)
 - re-train on actual game positions
 - eval-1 on non-capture positions
- Other data mining techniques



Conclusions

- Successfully extracted knowledge from the Awari endgame database
- Built relatively good evaluation functions
- eval-1 and eval-2 also work well for unbalanced positions (*eg.* diff=3), and can be further improved
- Discovered knowledge enhances human understanding of Awari