Compte rendu 31-03-2011
Opening prediction model
(opening prediction and tech tree updating)

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1 Goal

The goal of this model is two-fold: keep an estimation of the enemy tech tree updated, and be able to have a distribution over (predict) her opening strategy/tech (closely related considering the opening). See also:

- CR 15-07-2010 (preliminary work)
- CR 05-11-2010 (first tech tree estimator model)
- CR 09-12-2010 (stable tech tree estimator model)
- `http://forum-fr.com/viewtopic.php?f=56&t=5088` (Appendix on openings)

2 Variables

- $X \in [\emptyset, building_1, building_2, techtrees, \dots]$ All the possible tech trees (see Example).
- $O_{i \in [\![1 \dots N]\!]} \in \{0, 1\}$ Have seen (observed) the given building (it can have been destroyed, it will stay "seen").
- $Op \in [opening_1 \dots opening_M]$ Various opening values (depending on the race).
- $\lambda \in \{0, 1\}$ Coherence variable (restraining X to possible values w.r.t to $O_{1:N}$)
- $T \in [\![1 \dots P]\!]$ Time in the game (for the moment 1 second timesteps).

3 Decomposition

$$
\begin{aligned}
& P(T, X, O_1 \dots O_N, Op, \lambda) \\
= \; & P(Op) \\
& P(X|Op) \qquad \text{(NEW!)} \\
& P(O_{1:N}) \\
& P(\lambda|X, O_{1:N}) \\
& P(T|X, Op)
\end{aligned}
$$

4 Parameters

$$\begin{aligned} & P(\lambda = 1|x, o_{1:N}) \\ = \ & 1 \text{ if } x \text{ can exist with } o_{1:N} \\ = \ & 0 \text{ else} \end{aligned}$$

$P(T|X, Op)$ Bell shapes (μ, σ^2) that will be learned from the replays (occurences in games).

$P(X|Op)$ Histograms, learned from the replays.

5 Questions

$$P(Searched|Known) = \frac{\sum_{Free} P(Searched, Free, Known)}{P(Known)}$$

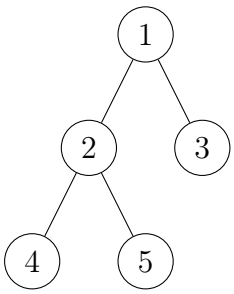
$$P(Op|T = t, O_{1:N} = o_{1:N}, \lambda = 1) \propto \frac{\sum_X P(Op).P(X|Op).P(o_{1:N}).P(\lambda|X, o_{1:N}).P(t|X, Op)}{P(o_{1:N}).P(\lambda).P(t)}$$

$$P(Op|T = t, O_{1:N} = o_{1:N}, \lambda = 1) \propto P(Op).P(o_{1:N}).\sum_X P(\lambda|X, o_{1:N}).P(X|Op).P(t|X, Op)$$

A little less interesting (tech tree given observations, pondered with what we saw during the learning):

$$P(X|T = t, O_{1:N} = o_{1:N}, \lambda = 1)$$

6 Example of a tech tree



$$O_{1:5} \in \{T, F\}$$

$$X \in \{x1(\emptyset), x2(1), x3(1,2), x4(1,3), x5(1,2,3) \dots$$

Bell shapes for $P(T|X, Op)$

With observation 5, only the tech trees containing 5 are possible, $P(\lambda = 1|X, o_5 = T) = 1$ for these X.