

Canonical Symmetries Tutorial

GamesCrafters 2006



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Canonical Symmetries Tutorial

Agenda

What are canonicals/symmetries

Why are they needed

Common symmetries

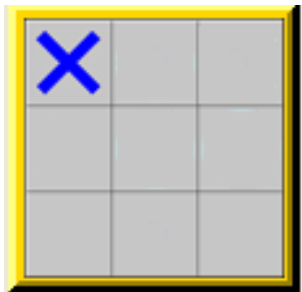
How to implement symmetries

What are canonical symmetries

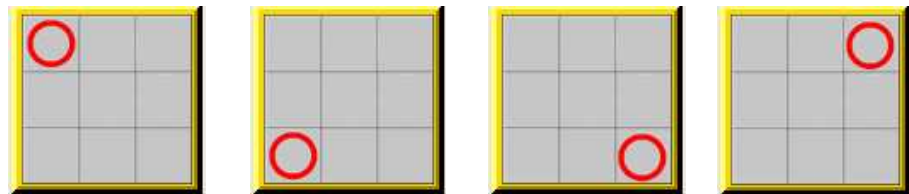
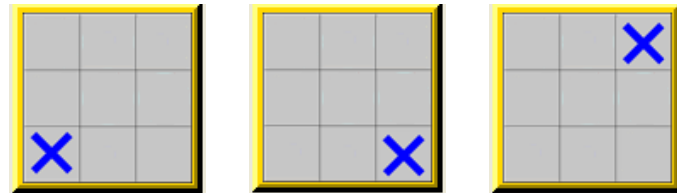
Symmetric positions are

Any positions that are the “same” for humans

But “different” for computers



Symmetric as



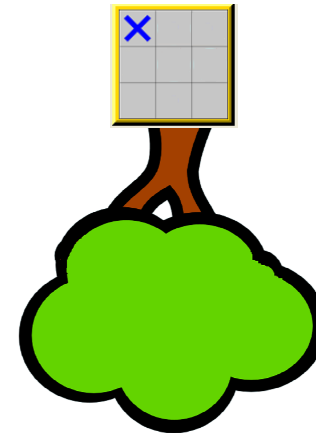
The position at left is the “canonical position” of all eight positions

Symmetries depend on game rules

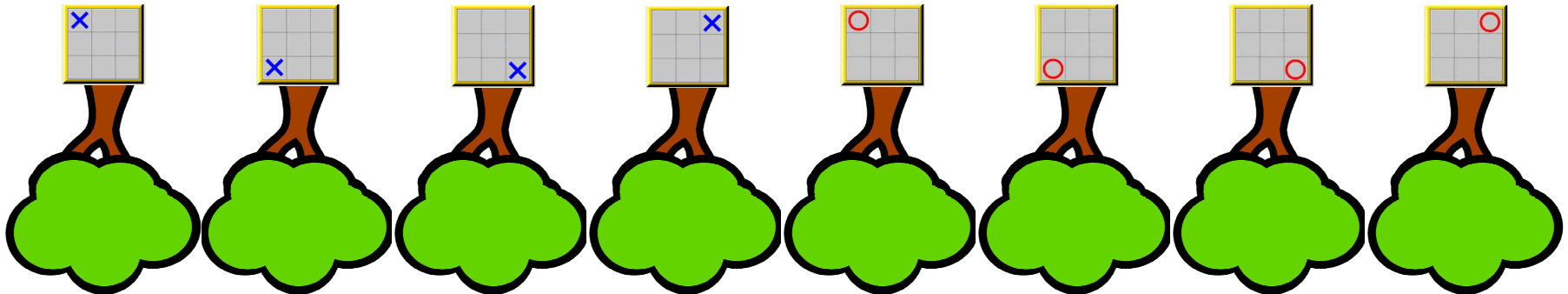
Why do we need symmetries

Computers are not very smart

Human solves



Computer solves



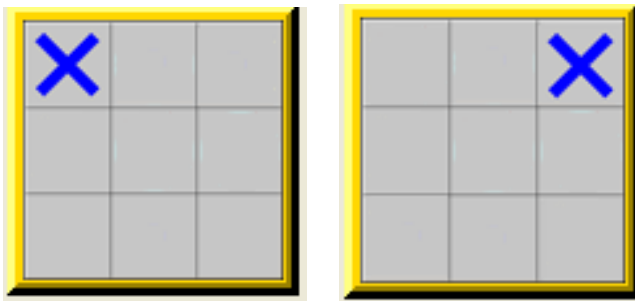
Highly inefficient!!!

Canonicals/symmetries lead to huge space and time savings

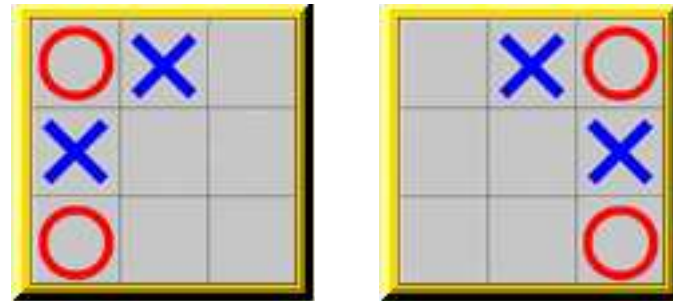
Common symmetries

Geometric symmetries

Rotation

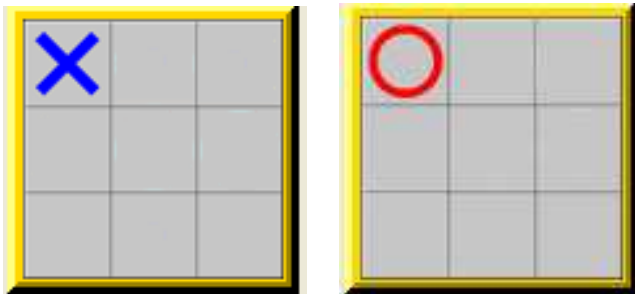


Reflection



Symmetries in pieces

Switching



Other equivalences in pieces

Other game specific stuff

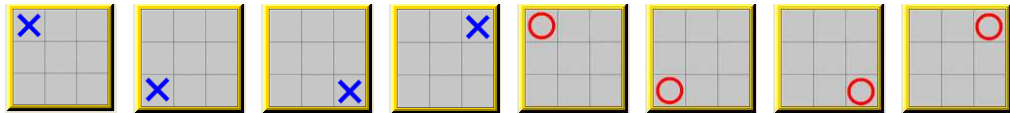
How to Implement Symmetries

Game modules need to implement only one function

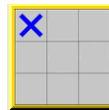
POSITION gCanonicalPosition (POSITION p);

Must adhere to interface

Takes in any position



Returns the canonical position



Freedom in implementing game specific canonicals

e.g. Quarto!

```
POSITION yanpeiGetCanonical(POSITION p);  
POSITION marioGetCanonical(POSITION position);  
POSITION (*getCanonical)(POSITION p) = &marioGetCanonical;
```

```
void InitializeGame () {  
.....  
    gCanonicalPosition = getCanonical;  
.....  
}
```

Multiple implementations



How to Turn on Symmetries

----- Main (Pre-Solved) Menu for Quarto -----

- s) (S)TART THE GAME
- w) START THE GAME (W)ITHOUT SOLVING

Evaluation Options:

- o) (O)bjective toggle from STANDARD to REVERSE
- d) (D)ebug Module BEFORE Evaluation
- g) (G)ame-specific options for Quarto
- 2) Toggle (2)-bit solving (currently OFF)
- p) Toggle Global (P)osition solving (currently OFF)
- l) Toggle (L)ow Mem solving (currently OFF)
- m) Toggle Sy(M)metries (currently OFF)
- h) (H)elp
- q) (Q)uit

Examples

Symmetries implemented in

Tic-Tac-Toe – Simple; mttt.c

Bagh Chal – Simple; mbaghchal.c

Quarto! – Not so simple; mquarto.c

Others?

Add to this list!!!

Summary

Symmetries = positions that are the “same” to humans

Need because wasteful to solve many symmetrical positions

Common symmetries – geometric, pieces

Implement using `POSITION gCanonicalPosition (POSITION p);`

Questions