CMSC 330: Organization of Programming Languages

Puzzle Game – Alligator Eggs!

- Hungry alligators – eat and guard family
- Old alligators – guard family
- Eggs – hatch into new family

Example Families

- Families are shown in columns
- Alligators guard families below them

Puzzle Rule 1 – Eating Rule

- If two families are side-by-side
  - The top left alligator
    - Eats the entire family to her right
    - Then dies
  - Any eggs she was guarding of the same color (as her)
    - Hatch into what she just ate (same number & color)

Eating Rule Practice

- What happens to these alligators?

Eating Rule Example
Eating Rule Example (cont.)

Puzzle Rule 2 – Color Rule
- If an alligator is about to eat a family and a color appears in both families
  - Need to change that color in the first family
  - Unless color only appear in eggs

Color Rule Example 1
- Apply rule
  - Green and red appear in both families
  - So switch greens to cyan, and reds to blue in family 1

Color Rule Example 2
- Apply rule
  - Orange and red appear in both families
    - But red appears only in eggs
  - So switch orange to green in family 1
    - Leave red alone

Puzzle Rule 3 – Old Alligator Rule
- Any old alligator that is guarding only 1 family dies

Puzzles!
- Reduce groups of alligators as much as possible using the 3 puzzle rules
More Puzzles!

Different color eggs

Naming Families

- **Family Not**
  - If eats Family True, becomes Family False
  - If eats Family False, becomes Family True

Alligator Eggs = Lambda Calculus

- A lambda calculus expression is defined as
  
  \[
  e ::= x \quad \text{variable (e: egg)}
  \]
  
  \[
  | \lambda x.e \quad \text{function } (\lambda x: \text{alligator})
  \]
  
  \[
  | e \ e \quad \text{function application (adjacency of families)}
  \]

Alligator Family = \(\lambda\)-Expression

- **Family**

- \(\lambda\)-expression
  - \((\lambda x.\lambda y.x \ y) \ \lambda z.\ y\)

Alligator Rules

- **Eating rule**
  - Beta reduction

- **Color rule**
  - Alpha renaming (to enable beta reduction)

- **Old alligator rule**
  - Parentheses

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Puzzle Game – Alligator Eggs

- From: http://worrydream.com/AlligatorEggs/

- Another way of thinking about lambda calculus