

Type Inference Exercises

Question 1:

Given this example, infer the types of H , I , and J :

```
def H x = (x + 1, x * 2);  
def I (a, b) = H a;  
def J (m, n) = m + " " + n;
```

- $H: \quad x \rightarrow \text{Pair}(x + 1, x * 2)$
 $\Rightarrow \quad \text{int} \rightarrow \text{Pair}(\text{int}, \text{int})$
- $I: \quad \text{Pair}(\alpha, \beta) \rightarrow H \alpha$
 $\Rightarrow \quad \text{Pair}(\text{int}, \beta) \rightarrow \text{Pair}(\text{int}, \text{int})$
- $J: \quad \text{Pair}(m, n) \rightarrow m + " " + n$
 $\Rightarrow \quad \text{Pair}(\text{str}, \text{str}) \rightarrow \text{String}$

Question 2:

```
fun A g x = g (x, x);  
fun B (m, n) = m + n;  
c = 5  
d = 10  
E = A B  
F = E c  
result = F d
```

- $A: \quad g \rightarrow x \rightarrow g_return$

$$(\text{Pair}(x, x) \rightarrow \gamma) \rightarrow x \rightarrow \gamma$$

Interpretation: function A takes in function g and type x and apply g to a pair of x , where:

$$\left\{ \begin{array}{l} \text{function } g: \quad \text{Pair}(x) \rightarrow \gamma \\ \text{type } x: \quad x \end{array} \right.$$

- $B: \quad \text{Pair}(m, n) \rightarrow m + n$
 $\Rightarrow \quad \text{Pair}(\text{int}, \text{int}) \rightarrow \text{int}$

- $E: \quad B \rightarrow A$
 $\Rightarrow \quad (\text{Pair}(\text{int}, \text{int}) \rightarrow \text{int}) \rightarrow \text{int} \rightarrow \text{int}$

Interpretation: function E applies function A to function B , since we know B is $\text{Pair}(\text{int}, \text{int}) \rightarrow \text{int}$, we can infer x is int and γ is also int .