Cálculo de Programas

Aula T01

J.N. Oliveira

From a mobile phone manufacturer

(...) For each **list of calls** *stored in the mobile phone (eg. numbers dialed, SMS messages, lost calls), the* **store** *operation should work in a way such that* **(a)** *the more recently a call is made the more accessible it is;* **(b)** *no number appears twice in a list;* **(c)** *only the last 10 entries in each list are stored.*

From a mobile phone manufacturer

```
store :: Call -> [Call] -> [Call]
store c l = take 10 (store' c l)

store' :: Call -> [Call] -> [Call]
store' c l = c : filter (/=c) l
```

From a mobile phone manufacturer

```
store :: Call -> [Call] -> [Call]
store c l = take 10 (c : filter (/=c) l)
```

Compare with ...

```
public void store10(string phoneNumber)
{
  System.Collections.ArrayList auxList =
      new System.Collections.ArrayList();
  auxList.Add(phoneNumber);
  auxList.AddRange(
      this.filteratmost9(phoneNumber) );
  this.callList = auxList;
}
```

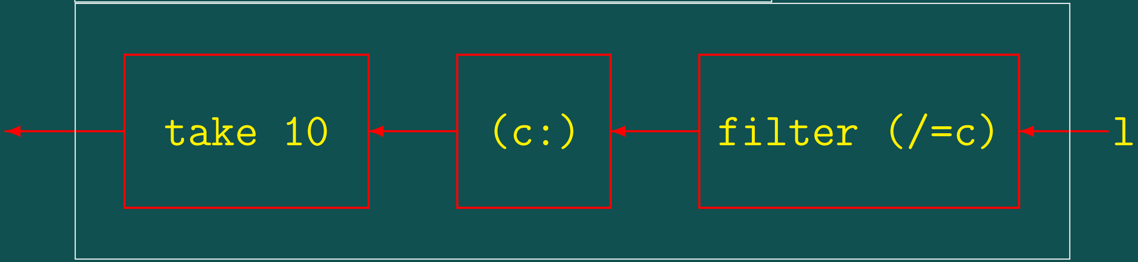
+ `filteratmost9` (next slide)

Compare with ...

```
public System.Collections.ArrayList filteratmost9(string n)
{
  System.Collections.ArrayList retList =
      new System.Collections.ArrayList();
      int i=0, m=0;
  while((i < this.callList.Count) && (m < 9))
  {
      if ((string)this.callList[i] != n)
      {
          retList.Add(this.callList[i]);
          m++;
      }
      i++;
  }
  return retList;
}
```

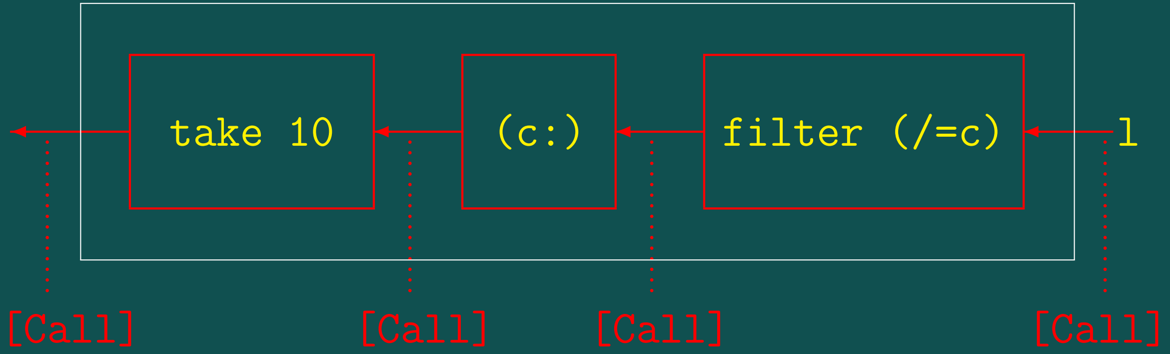
From a mobile phone manufacturer

```
store c :: [Call] -> [Call]
```

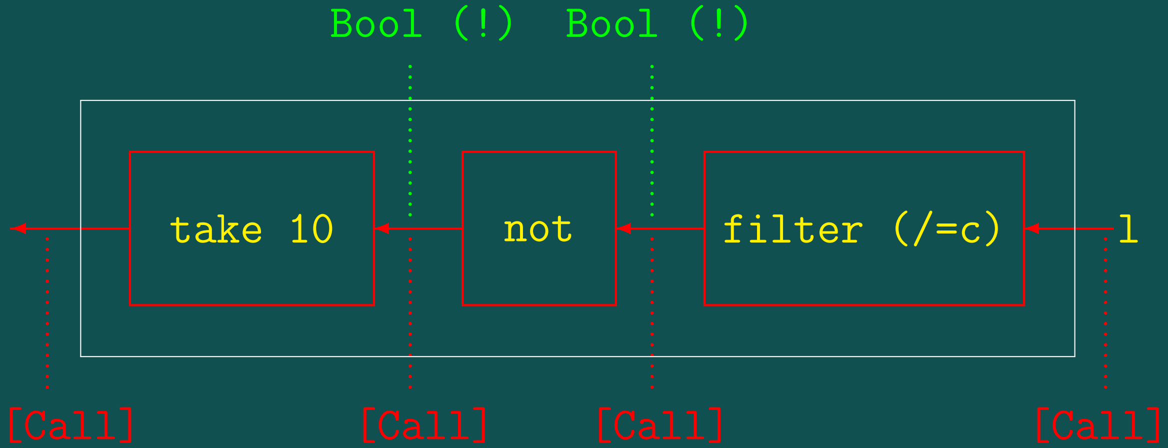


From a mobile phone manufacturer

`store c :: [Call] -> [Call]`

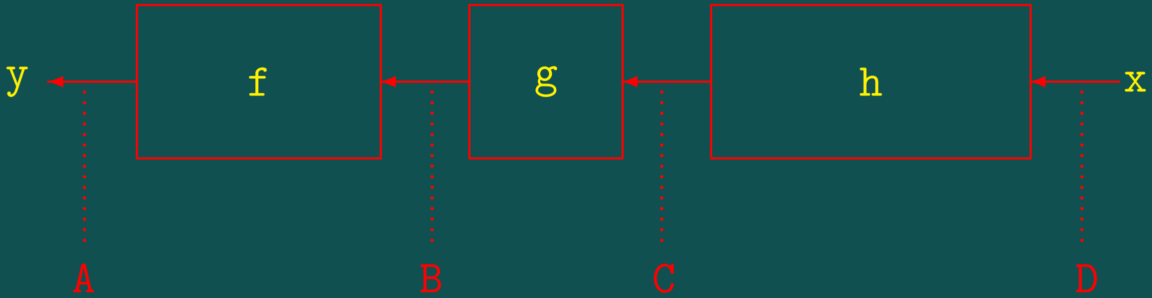


Uups!



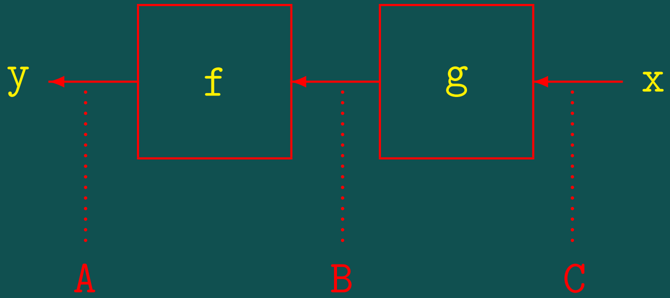
Em geral

```
y = f(g(h x))
```



Em geral

$$y = f(g\ x)$$



Simplificação

```
y = f(g x)
```

$$A \xleftarrow{f} B \xleftarrow{g} C$$

Composição

$$\texttt{y = f(g x)}$$

$$\begin{tikzcd} A & B \arrow[l, "f"'] & C \arrow[l, "g"'] \end{tikzcd}$$

$$\begin{tikzcd} A & C \arrow[l, "f \cdot g"'] \end{tikzcd}$$

$$\texttt{y = (f} \cdot \texttt{g) x}$$

Composição

$$(f \cdot g) \cdot h = f \cdot (g \cdot h)$$

Composição

$$(f \cdot g) \cdot h = f \cdot (g \cdot h)$$
$$(a + b) + c = a + (b + c)$$

Composição

$$(f \cdot g) \cdot h = f \cdot (g \cdot h)$$
$$(a + b) + c = a + (b + c)$$

$$f \cdot g \cdot h$$
$$a + b + c$$

Composição

$$\mathit{store}\ c = \mathit{take}\ 10 \cdot \underbrace{(c:) \cdot \mathit{filter}\ (\neq c)}_{\mathit{store}'\ c}$$

Composição

$$\mathit{store}\ c = \mathit{take}\ 10 \cdot \underbrace{(c{:}) \cdot \mathit{filter}\ ({\neq}c)}_{\mathit{store}'\ c}$$

isto é

$$\mathit{take}\ 10 \cdot ((c{:}) \cdot \mathit{filter}\ ({\neq}c))$$

Composição

$$store\ c = take\ 10 \cdot \underbrace{(c:) \cdot filter\ (\neq c)}_{store'\ c}$$

isto é

$$take\ 10 \cdot ((c:) \cdot filter\ (\neq c))$$

igual a

$$(take\ 10 \cdot (c:)) \cdot filter\ (\neq c)$$

Composição

$$(f \cdot g) \cdot h \;=\; f \cdot (g \cdot h)$$

$$(a + b) + c \;=\; a + (b + c)$$

Composição

$$(f \cdot g) \cdot h \;=\; f \cdot (g \cdot h)$$
$$(a + b) + c \;=\; a + (b + c)$$

$$a + 0 = 0 + a = a$$

Composição

$$(f \cdot g) \cdot h \;=\; f \cdot (g \cdot h)$$
$$(a + b) + c \;=\; a + (b + c)$$

$$a + 0 = 0 + a = a$$
$$f \cdot ? = ? \cdot f = f$$

$$A \xleftarrow{f} B \xleftarrow{g} C$$

$$C \xrightarrow{g} B \xrightarrow{f} A$$

$$C \xrightarrow{g} B \xrightarrow{f} A$$

A


A

$$A \longleftarrow A$$

$$A \xleftarrow{id} A$$

$$A \xleftarrow{id} A$$

$$id\ a = a$$

Identidade

$$
\begin{tikzcd}
A \arrow[d, "f"'] & A \arrow[l, "id"'] \\
B &
\end{tikzcd}
$$

Identidade

$$
\begin{tikzcd}
A \arrow[d, "f"'] & A \arrow[l, "id"'] \arrow[d, "f"] \\
B & B
\end{tikzcd}
$$

Identidade

$$
\begin{tikzcd}
A \arrow[d, "f"'] & A \arrow[l, "id"'] \arrow[d, "f"] \\
B & B \arrow[l, "id"]
\end{tikzcd}
$$

Identidade

$$
\begin{tikzcd}
A \arrow[d, "f"'] & A \arrow[l, "id"'] \arrow[dl, "f"'] \arrow[d, "f"] \\
B & B \arrow[l, "id"]
\end{tikzcd}
$$

Identidade

$$
\begin{tikzcd}
A \arrow[d, "f"'] & A \arrow[l, "id"'] \arrow[d, "f"] \arrow[dl, "f"'] \\
B & B \arrow[l, "id"]
\end{tikzcd}
$$

$$f \cdot id = f = id \cdot f$$

Composição e identidade

Associatividade:

$$(f \cdot g) \cdot h = f \cdot (g \cdot h)$$

Composição e identidade

Associatividade:

$$(f \cdot g) \cdot h = f \cdot (g \cdot h)$$

" Natural-*id*" :

$$f \cdot id = f = id \cdot f$$

$$f \cdot g$$

$$f \cdot g$$

$$f \times g \, ?$$

$$f \cdot g$$

$$f \times g \; ?$$

$$f + g \; ?$$