

Evaluating Invariances in Document Layout Functions

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Variable Data Printing

- **Digital offset presses allow for short runs**
- **Each document potentially unique**
- **Pre-rasterisation not always feasible:**
 - **Double sided A4 page @ 600ppi 24bpp = 180 MB**
 - **500 page catalogue = 90 GB**
 - **1,000,000 unique catalogs = 90 PB**

Optimising Variable Data Documents

- **Potentially unique, probably quite similar**
- **Analysis of document to find invariant sections**
- **Invariant sections can be rasterised for re-use**
- **Could be used to generate efficient PPML**

Progressive Document Evaluation

- **A document is a tree of nested functions and content**
- **Unbound items exist where future content will be placed**
- **As more items become bound more invariant sections will be discovered**

Layout Functions

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- **FREE delivery** over £99
- With **Clubcard Points**



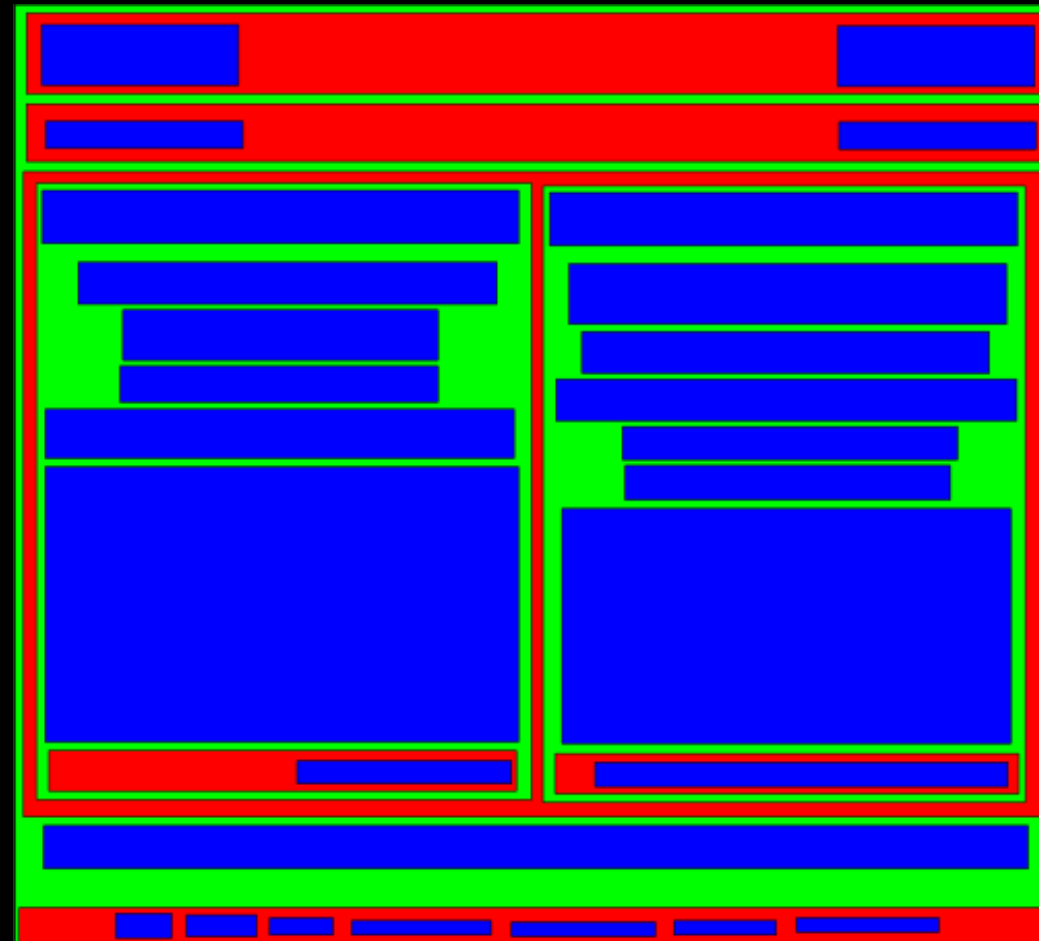
up to **50% off** selected lines

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Layout Functions 2



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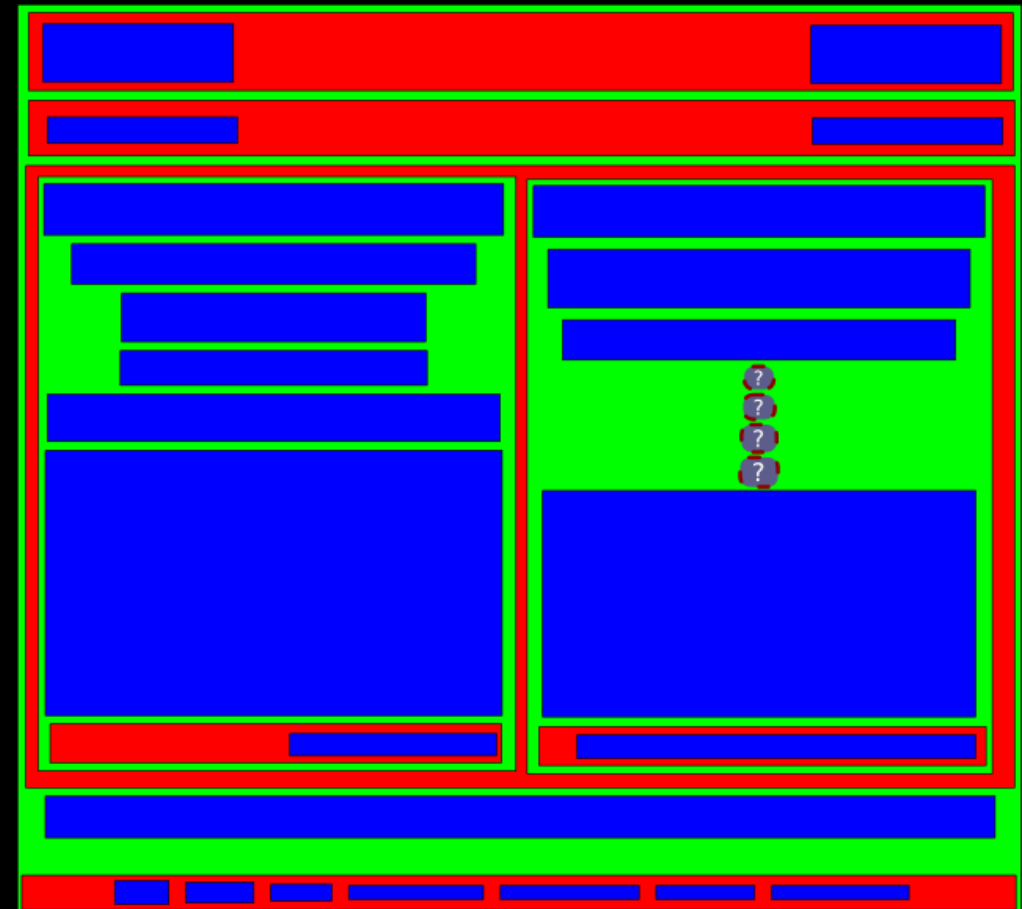
up to **50% off** selected lines

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WINE CLUB Wine by the case

- **All 800 instore wines**, plus many **internet exclusives** & mixed cases*
- **5% off** included on all cases**
- 1 hour delivery slots on weekdays
- 2 hour delivery slots on the weekend
- **FREE** delivery on the weekend
- **FREE** delivery over £50 on weekdays



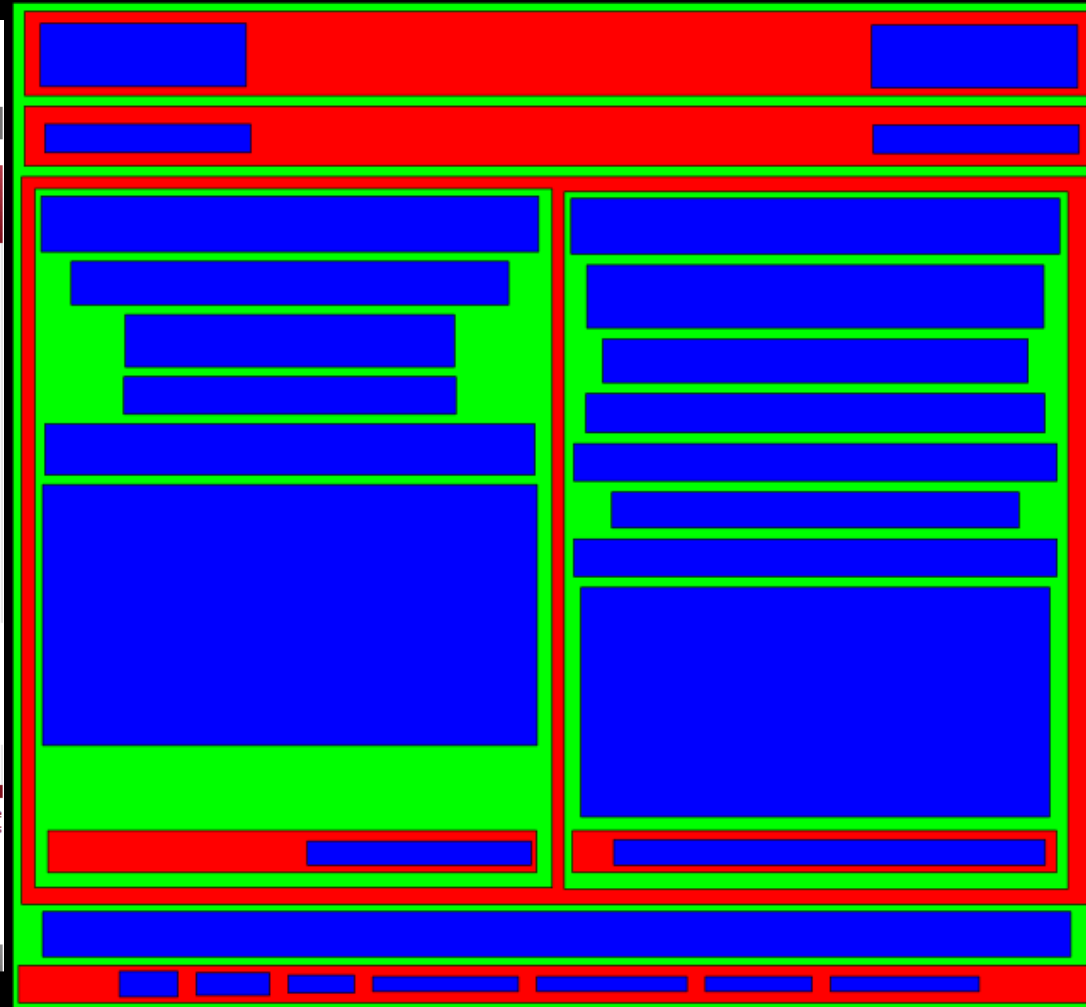
up to 50% off
selected lines

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Dealing with Unbound Items

- **linear flows exhibit associativity:**

$$f(a, f(b, c)) == f(f(a, b), c)$$

- **Associativity allows successive bound items to be evaluated:**

$$\begin{aligned} f(u, b, b, u, u, b, b) &== f(u, f(b, b), u, u, f(b, b)) \\ &== f(u, b, u, u, b) \end{aligned}$$

- **A bound item at the head of a flow can be moved outside:**

$$f(b, u, b, u) == b, f'(u, b, u)$$

Implementation

- **SVG with elements from the “layout” namespace**
- **Layout processor takes two inputs:**
 - **Document to be processed**
 - **Data to replace an unbound item**
- **After all unbound items have been bound the document is fully evaluated to renderable SVG**

Example

```
<layout:xflow>
```

```
  <svg:svg/>
```

```
  <svg:svg/>
```

```
  <layout:unbound id="xflow:a"/>
```

```
  <layout:yflow>
```

```
    <svg:svg/>
```

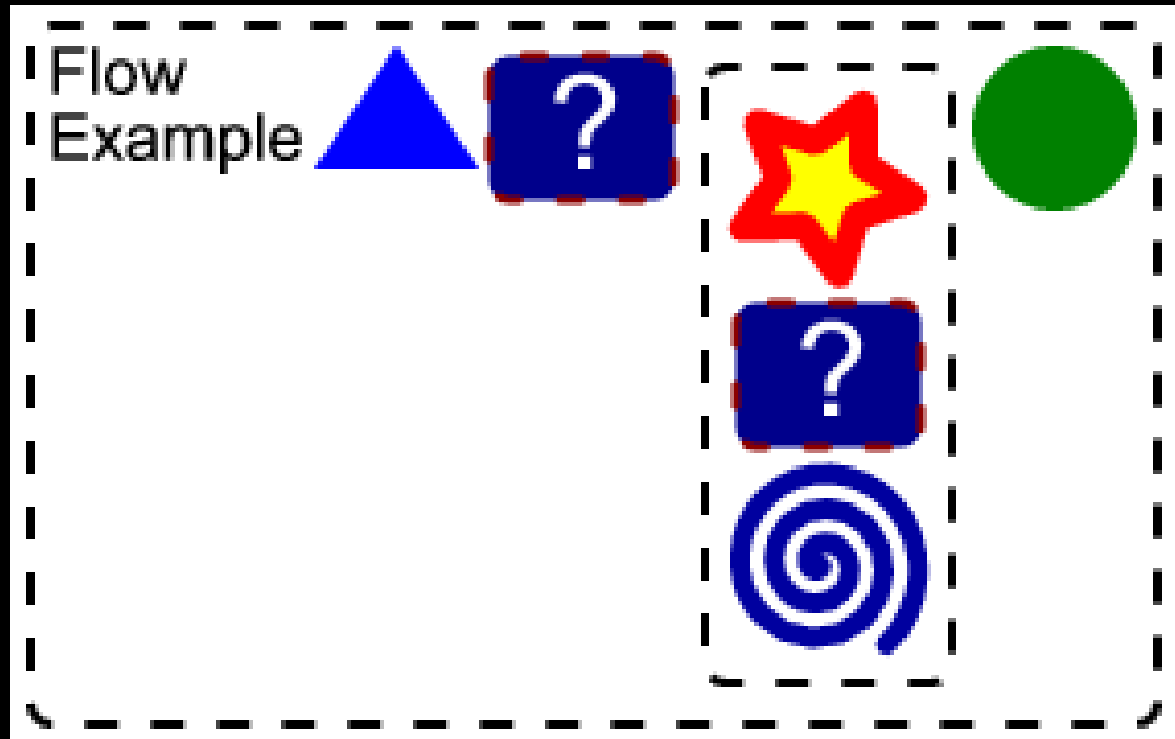
```
    <layout:unbound id="yflow:a"/>
```

```
    <svg:svg/>
```

```
  </layout:yflow>
```

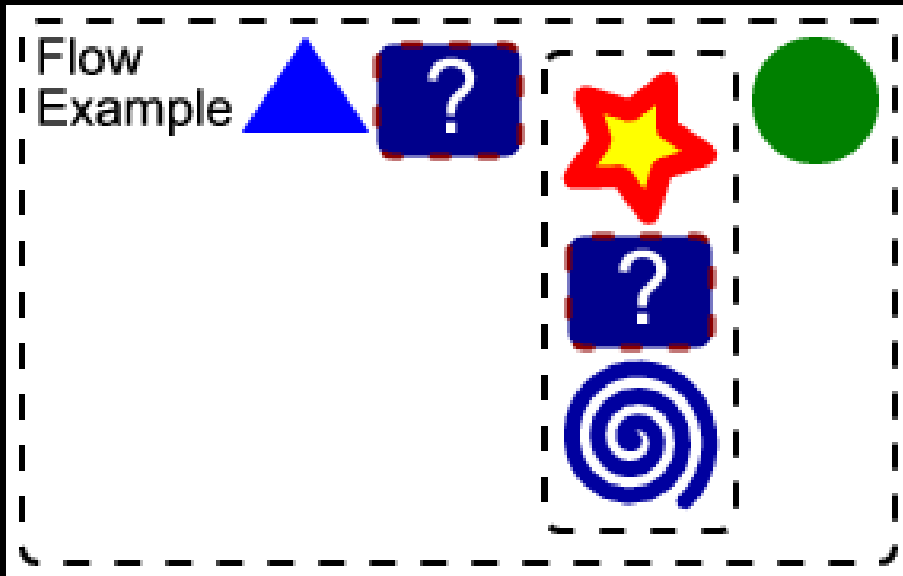
```
  <svg:svg/>
```

```
</layout:xflow>
```

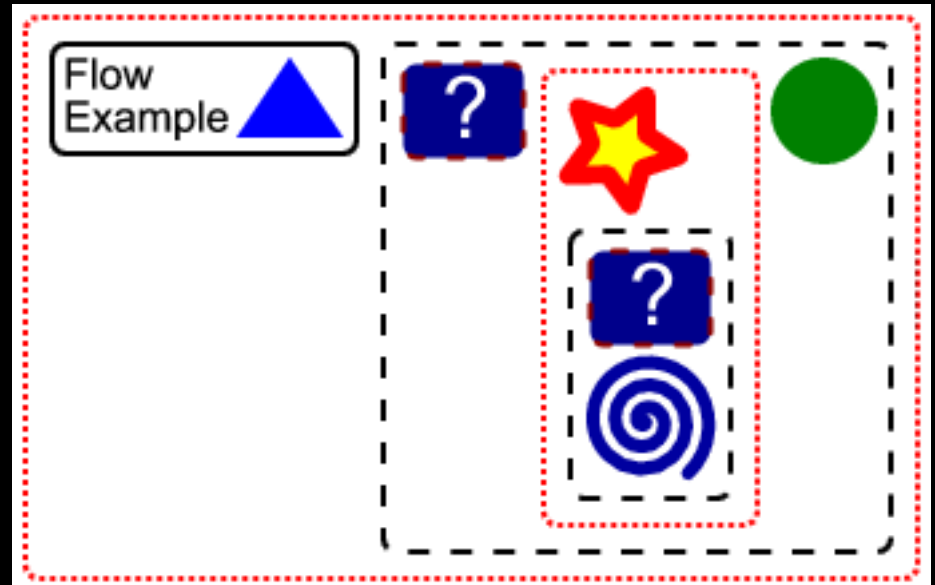


Example

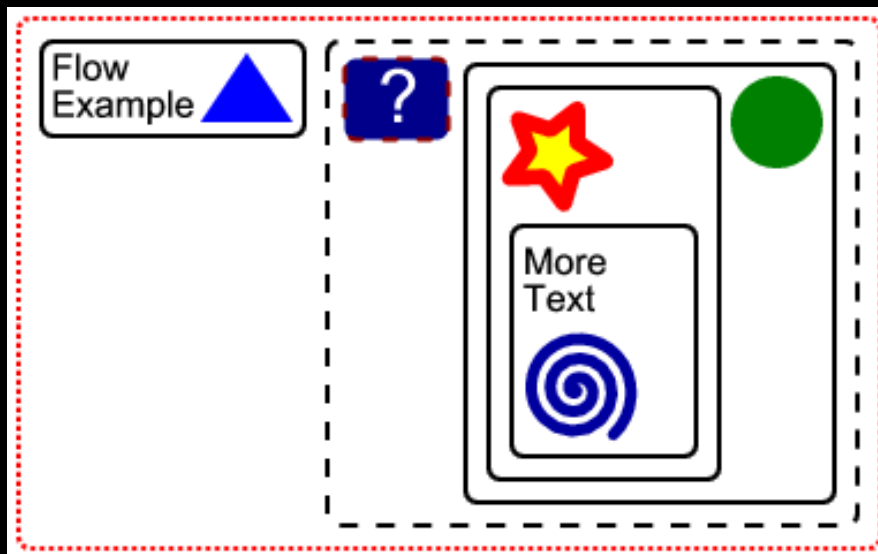
1



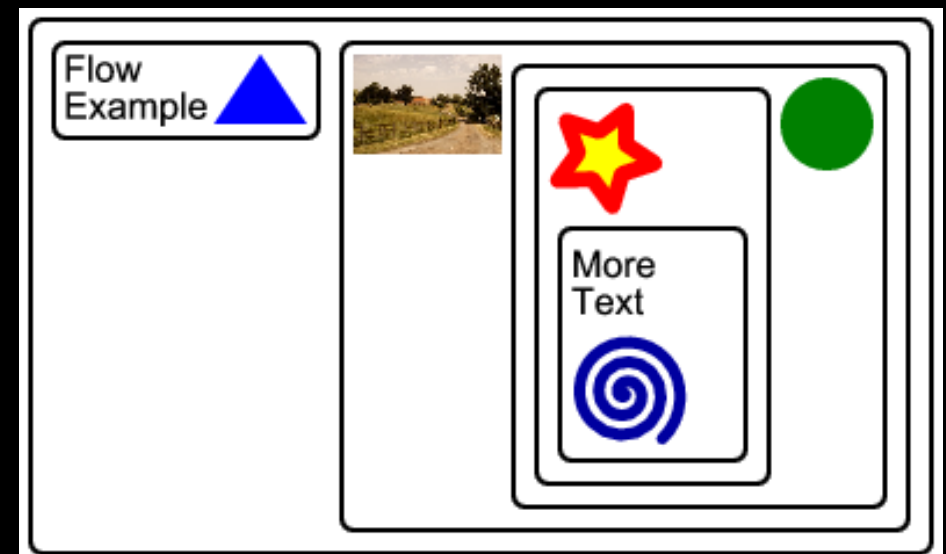
2



3



4



Conclusion

- **Progressive evaluation of documents is beneficial to VDP**
- **Future work will look at applying more program reasoning techniques from the FP community to documents**

Questions?