New Over-Approximate Examples

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⇒ over-approximate dependency between variable outside loop. v.s. inside.

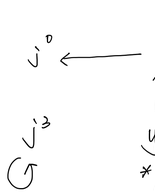
⇒ change a constant assignment for variable x outside loop.

will cause sequence of difference for variable y inside loop. if $y \in x$.

⇒ dependency actually 1. but edge weight is iteration #.

Example:

```
[j ← k]^0
[x ← query(0)]^1
while [j ≥ 0]^2 do
    [j ← j - 1]^3
    [y ← query(x)]^4.
```



edge (y^4, x^1).

$\tau_0 = [(k, in, \cdot), \cdot)]$.

$[(j,2)$ $(x, 1, V_1, 0), (j, 1), (y, 4, V_2, V_1)$ ⇒ $Seq(\tau_1, \tau_2, y^4)$

$(j, 0)$ $(y, 4, V_2', V_1), (j, -1), (y, 4, V_2'', V_1)]$ ⇒ $[V_1; V_1, V_1]$

$[V_1', V_1', V_1']$.

$[(j, 1),$ $(x, 1, V_1', 0)$ $(y, 4, V_2, V_1'')$

$(y, 4, V_2', V_1'')$ $(y, 4, V_2'', V_1'')]$

⇒ $|Diff| = 3$.

⇒ $w = \tau \to \tau k$.

⇒ 2 ways:

I ✓ consider both vertices weight & ~~edge~~ weight. v.

restricted walk : $\tau_0 \to$

$\{$ edge seq : $(e_1, \cdots e_n)$ s.t. $cnt(e_i) \leq w_{e_i}(\tau_0)$

with Vertices seq $(v_1, \cdots v_{n+1})$. $cnt(v_i) \leq w_{v_i}(\tau_0)$.

$flen(k, c) : \tau_0 \to \mathbb{N}$

⇒ $flen(k, c)(\tau_0) = \#\{ 1 \mid v_i \in QV(c) \wedge v_i \in k(\tau_0) \wedge k \in WALK(c) \}$.

⇒ $A(c) : \tau_0 \to \mathbb{N}$.

$A(c) = \tau_0 \to \max\{ flen(k, c)(\tau_0) \mid k \in WK(c) \}$.

⇓

better ?

both works.

⇒ better.

II:

$Diff\ seq(\tau_1, \tau_2, x^l) \triangleq$

$\{ k \mid (k = 0 \wedge Seq_{f_1}[0] \neq Seq_{f_2}[0]$. or $Seq_{f_1} = [])$

$\vee$ $(k = 1 \ldots len(Seq_{f_2}),\ Seq_{f_2}[k-1] \neq Seq_{f_2}[k]) \}$.

$\cup \{ Seq_{f_1}[0] \mid Seq_{f_2} = [] \}$.

$Diff \triangleq (len(Seq_{f_1}) \neq len(Seq_{f_2})) \vee (Seq_{f_1}[0] \neq Seq_{f_2}[0])$

⇒ $Diff\ seq(\tau_1, \tau_2, x^l) \triangleq$

$\{ v \mid v = Seq_{f_1}[0]$ $(Seq_{f_1} \neq [] \wedge Seq_{f_2} = [])$

$v = Seq_{f_2}[k]$ $(Seq_{f_2} \neq [] \wedge Seq_{f_1} = [] \wedge Seq[k] \neq Seq_{f_2}[k+1],\ k = 0, \ldots len(Seq_{f_2}))$

$v = Seq_{f_2}[k]$ $(Seq_{f_2} \neq [] \wedge Seq_{f_1} \neq [] \wedge Seq_{f_1}[0] \neq Seq_{f_2}[0],\ Seq[k] \neq Seq_{f_2}[k+1],\ k = 0, \ldots len(Seq_{f_2}))$ $\}$

⇒ $|Diff(\tau_1, \tau_2, y)|$ in example is 1. ⇒ weight of edge $\tau \to 1$ ⇐.

but it causes over approximate still.

because even if $Seq[k+1] \neq Seq[k]$, the variation still doesn't comes from modification of variable outside of loop.

$|Diff| = 1$.