Graph Coloring
interference graph

• Two variables can be assigned to the same register if they are not live at the same time
  • They don’t have values we need at the same time

• Graph $G = (V, E)$ where
  • $V$ a set of vertices representing variables/temporaries
  • $E$ a set of edges of form $(v_1, v_2)$ if $v_1$ and $v_2$ are live at the same time

1: $T1 = A + B$
2: $T2 = A + T1$
3: $T3 = A + T2$
4: $D = A + T3$
5: $T4 = C + B$
6: $T5 = T4 + C$
7: $E = T5 + D$

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$\text{[A, B]}$\[A, B, T1]\[A, B, T2]\[A, B, T3]\[B, C, D]\[T4, C, D]\[T5, D]\[E]$
interference graph

1:  \[ T_1 = A + B \]
2:  \[ T_2 = A + T_1 \]
3:  \[ T_3 = A + T_2 \]
4:  \[ D = A + T_3 \]
5:  \[ T_4 = C + B \]
6:  \[ T_5 = T_4 + C \]
7:  \[ E = T_5 + D \]

- \([A, B]\)
- \([A, B, T_1]\)
- \([A, B, T_2]\)
- \([A, B, T_3]\)
- \([B, C, D]\)
- \([T_4, C, D]\)
- \([T_5, D]\)
- \([E]\)
graph coloring

• Assign variables to registers by *coloring* the graph, one color per register

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\begin{align*}
1: & \quad T1 = A + B \\
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3: & \quad T3 = A + T2 \\
4: & \quad D = A + T3 \\
5: & \quad T4 = C + B \\
6: & \quad T5 = T4 + C \\
7: & \quad E = T5 + D
\end{align*}
\]
graph coloring

- No vertices that share an edge get the same color.
graph coloring

- Multiple valid coloring: looking for **minimal coloring**

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1:  T1 = A + B   [A, B]
2:  T2 = A + T1  [A, B, T1]
3:  T3 = A + T2  [A, B, T2]
4:  D = A + T3  [A, B, T3]
5:  T4 = C + B  [B, C, D]
6:  T5 = T4 + C  [T4, C, D]
7:  E = T5 + D  [T5, D]
```
next: finding a minimum coloring