עבודה 4 בעקרונות שפות תכנות

# חלק 1

שאלה 1

נבצע Type inference לפונקציה הנתונה על פי שלבי האלגוריתם המתאים.

((lambda (x1 y1) (if (> x1 y1) #t #f)) 8 3)

שלב 1: Renaming – אין שינוי בשמות המשתנים.

שלב 2: התאמת משתני טיפוס לכל תתי הביטויים.

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| **Var** | **Expression** |
| T0 | ((lambda (x1 y1) (if (> x1 y1) #t #f)) 8 3) |
| T1 | (lambda (x1 y1) (if (> x1 y1) #t #f)) |
| Tif | (if (> x1 y1) #t #f) |
| Ttest | (> x1 y1) |
| T> | > |
| Tx1 | x1 |
| Ty1 | y1 |
| T#t | #t |
| T#f | #f |
| Tnum8 | 8 |
| Tnum3 | 3 |

שלב 3: בניית משוואות טיפוסים

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| **Equation** | **Expression** |
| T1 = [Tnum8 \* Tnum3 → T0] | ((lambda (x1 y1) (if (> x1 y1) #t #f)) 8 3) |
| T1 = [Tx1 \* Ty1 → Tif] | (lambda (x1 y1) (if (> x1 y1) #t #f)) |
| Tif = T#t  Ttest = boolean  T#t = T#f | (if (> x1 y1) #t #f) |
| T> = [Tx1 \* Ty1 → Ttest] | (> x1 y1) |
| T> = [number \* number → boolean] | > |
| T#t = boolean | #t |
| T#f = boolean | #f |
| Tnum8 = number | 8 |
| Tnum3 = number | 3 |

שלב 4: פתרון המשוואות

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| **Substitution** | **Equation** |
|  | T1 = [Tnum8 \* Tnum3 → T0] |
| T1 = [Tx1 \* Ty1 → Tif] |
| Tif = T#t |
| Ttest = boolean |
| T#t = T#f |
| T> = [Tx1 \* Ty1 → Ttest] |
| T> = [number \* number → boolean] |
| T#t = boolean |
| T#f = boolean |
| Tnum8 = number |
| Tnum3 = number |

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| **Substitution** | **Equation** |
| T1 = [Tnum8 \* Tnum3 → T0] | T1 = [Tx1 \* Ty1 → Tif] |
| Tif = T#t |
| Ttest = boolean |
| T#t = T#f |
| T> = [Tx1 \* Ty1 → Ttest] |
| T> = [number \* number → boolean] |
| T#t = boolean |
| T#f = boolean |
| Tnum8 = number |
| Tnum3 = number |

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| **Substitution** | **Equation** |
| T1 = [Tnum8 \* Tnum3 → T0] | Tif = T#t |
| Ttest = boolean |
| T#t = T#f |
| T> = [Tx1 \* Ty1 → Ttest] |
| T> = [number \* number → boolean] |
| T#t = boolean |
| T#f = boolean |
| Tnum8 = number |
| Tnum3 = number |
| Tx1 = Tnum8 |
| Ty1 = Tnum3 |
| Tif = T0 |

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| **Substitution** | **Equation** |
| T1 = [Tnum8 \* Tnum3 → T0]  Tif = T#t  Ttest = boolean | T#t = T#f |
| T> = [Tx1 \* Ty1 → Ttest] |
| T> = [number \* number → boolean] |
| T#t = boolean |
| T#f = boolean |
| Tnum8 = number |
| Tnum3 = number |
| Tx1 = Tnum8 |
| Ty1 = Tnum3 |
| Tif = T0 |

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| **Substitution** | **Equation** |
| T1 = [Tnum8 \* Tnum3 → T0]  Tif = T#f  Ttest = boolean  T#t = T#f | T> = [Tx1 \* Ty1 → Ttest] |
| T> = [number \* number → boolean] |
| T#t = boolean |
| T#f = boolean |
| Tnum8 = number |
| Tnum3 = number |
| Tx1 = Tnum8 |
| Ty1 = Tnum3 |
| Tif = T0 |

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| **Substitution** | **Equation** |
| T1 = [Tnum8 \* Tnum3 → T0]  Tif = T#f  Ttest = boolean  T#t = T#f | T> = [Tx1 \* Ty1 → boolean] |
| T> = [number \* number → boolean] |
| T#t = boolean |
| T#f = boolean |
| Tnum8 = number |
| Tnum3 = number |
| Tx1 = Tnum8 |
| Ty1 = Tnum3 |
| Tif = T0 |

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| **Substitution** | **Equation** |
| T1 = [Tnum8 \* Tnum3 → T0]  Tif = T#f  Ttest = boolean  T#t = T#f  T> = [Tx1 \* Ty1 → boolean] | T> = [number \* number → boolean] |
| T#t = boolean |
| T#f = boolean |
| Tnum8 = number |
| Tnum3 = number |
| Tx1 = Tnum8 |
| Ty1 = Tnum3 |
| Tif = T0 |

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| **Substitution** | **Equation** |
| T1 = [Tnum8 \* Tnum3 → T0]  Tif = T#f  Ttest = boolean  T#t = T#f  T> = [Tx1 \* Ty1 → boolean]  T> = [number \* number → boolean] | T#t = boolean |
| T#f = boolean |
| Tnum8 = number |
| Tnum3 = number |
| Tx1 = Tnum8 |
| Ty1 = Tnum3 |
| Tif = T0 |
| Tx1 = number |
| Ty1 = number |
| boolean = boolean |

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| **Substitution** | **Equation** |
| T1 = [Tnum8 \* Tnum3 → T0]  Tif = T#f  Ttest = boolean  T#t = T#f  T> = [Tx1 \* Ty1 → boolean]  T> = [number \* number → boolean]  T#t = boolean | T#f = boolean |
| Tnum8 = number |
| Tnum3 = number |
| Tx1 = Tnum8 |
| Ty1 = Tnum3 |
| Tif = T0 |
| Tx1 = number |
| Ty1 = number |
| boolean = boolean |

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| **Substitution** | **Equation** |
| T1 = [Tnum8 \* Tnum3 → T0]  Tif = boolean  Ttest = boolean  T#t = boolean  T> = [Tx1 \* Ty1 → boolean]  T> = [number \* number → boolean]  T#t = boolean  T#f = boolean | Tnum8 = number |
| Tnum3 = number |
| Tx1 = Tnum8 |
| Ty1 = Tnum3 |
| Tif = T0 |
| Tx1 = number |
| Ty1 = number |
| boolean = boolean |

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| **Substitution** | **Equation** |
| T1 = [number \* number → T0]  Tif = boolean  Ttest = boolean  T#t = boolean  T> = [Tx1 \* Ty1 → boolean]  T> = [number \* number → boolean]  T#t = boolean  T#f = boolean  Tnum8 = number  Tnum3 = number | Tx1 = Tnum8 |
| Ty1 = Tnum3 |
| Tif = T0 |
| Tx1 = number |
| Ty1 = number |
| boolean = boolean |

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| **Substitution** | **Equation** |
| T1 = [number \* number → T0]  Tif = boolean  Ttest = boolean  T#t = boolean  T> = [Tx1 \* Ty1 → boolean]  T> = [number \* number → boolean]  T#t = boolean  T#f = boolean  Tnum8 = number  Tnum3 = number | Tx1 = number |
| Ty1 = Tnum3 |
| Tif = T0 |
| Tx1 = number |
| Ty1 = number |
| boolean = boolean |

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| **Substitution** | **Equation** |
| T1 = [number \* number → T0]  Tif = boolean  Ttest = boolean  T#t = boolean  T> = [number \* Ty1 → boolean]  T> = [number \* number → boolean]  T#t = boolean  T#f = boolean  Tnum8 = number  Tnum3 = number  Tx1 = number | Ty1 = Tnum3 |
| Tif = T0 |
| Tx1 = number |
| Ty1 = number |
| boolean = boolean |

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| **Substitution** | **Equation** |
| T1 = [number \* number → T0]  Tif = boolean  Ttest = boolean  T#t = boolean  T> = [number \* Ty1 → boolean]  T> = [number \* number → boolean]  T#t = boolean  T#f = boolean  Tnum8 = number  Tnum3 = number  Tx1 = number | Ty1 = number |
| Tif = T0 |
| Tx1 = number |
| Ty1 = number |
| boolean = boolean |

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| --- | --- |
| **Substitution** | **Equation** |
| T1 = [number \* number → T0]  Tif = boolean  Ttest = boolean  T#t = boolean  T> = [number \* number → boolean]  T> = [number \* number → boolean]  T#t = boolean  T#f = boolean  Tnum8 = number  Tnum3 = number  Tx1 = number  Ty1 = number | Tif = T0 |
| Tx1 = number |
| Ty1 = number |
| boolean = boolean |
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| **Substitution** | **Equation** |
| T1 = [number \* number → T0]  Tif = boolean  Ttest = boolean  T#t = boolean  T> = [number \* number → boolean]  T> = [number \* number → boolean]  T#t = boolean  T#f = boolean  Tnum8 = number  Tnum3 = number  Tx1 = number  Ty1 = number  Tif = T0 | Tx1 = number |
| Ty1 = number |
| boolean = boolean |

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| **Substitution** | **Equation** |
| T1 = [number \* number → T0]  Tif = boolean  Ttest = boolean  T#t = boolean  T> = [number \* number → boolean]  T> = [number \* number → boolean]  T#t = boolean  T#f = boolean  Tnum8 = number  Tnum3 = number  Tx1 = number  Ty1 = number  Tif = T0 | ~~T~~~~x1~~ ~~= number~~ |
| ~~T~~~~y1~~ ~~= number~~ |
| ~~boolean = boolean~~ |