Aufgabe 02a

$$(\lambda f x. \underbrace{f x}_{GV=\{f,x\}})(\underbrace{\lambda z y.x y}_{FV=\{x\}})x$$

Aufgabe 02a

$$(\lambda fx.\ \underbrace{fx}_{GV=\{f,x\}}\ )(\underbrace{\lambda zy.xy}_{FV=\{x\}})x$$

$$\Rightarrow_\alpha (\lambda fx'.\ \underbrace{fx'}_{GV=\{f,x'\}}\ )(\underbrace{\lambda zy.xy}_{FV=\{x\}})x$$

Aufgabe 02a

$$(\lambda fx.\ \underbrace{fx}_{GV=\{f,x\}}\ )(\underbrace{\lambda zy.xy}_{FV=\{x\}})x$$

$$\Rightarrow_\alpha (\lambda fx'.\ \underbrace{fx'}_{GV=\{f,x'\}}\ )(\underbrace{\lambda zy.xy}_{FV=\{x\}})x$$

$$\Rightarrow_\beta (\lambda x'.\underbrace{(\lambda zy.xy)x'}_{GV=\{x'\}})\ \underbrace{x}_{FV=\{x\}}$$

Aufgabe 02a

$$(\lambda f x. \underbrace{f x}_{GV=\{f,x\}})(\underbrace{\lambda zy.xy}_{FV=\{x\}})x$$

$$\Rightarrow_\alpha (\lambda f x'. \underbrace{f x'}_{GV=\{f,x'\}})(\underbrace{\lambda zy.xy}_{FV=\{x\}})x$$

$$\Rightarrow_\beta (\lambda x'. \underbrace{(\lambda zy.xy)x'}_{GV=\{x'\}}) \underbrace{x}_{FV=\{x\}}$$

$$\Rightarrow_\beta (\lambda zx. \underbrace{xy}_{GV=\{y\}}) \underbrace{x}_{FV=\{x\}}$$

Aufgabe 02a

$$(\lambda f x. \underbrace{f x}_{GV=\{f,x\}})(\underbrace{\lambda zy.xy}_{FV=\{x\}})x$$

$$\Rightarrow_\alpha (\lambda f x'. \underbrace{f x'}_{GV=\{f,x'\}})(\underbrace{\lambda zy.xy}_{FV=\{x\}})x$$

$$\Rightarrow_\beta (\lambda x'. \underbrace{(\lambda zy.xy)x'}_{GV=\{x'\}})\underbrace{x}_{FV=\{x\}}$$

$$\Rightarrow_\beta (\lambda zx. \underbrace{xy}_{GV=\{y\}})\underbrace{x}_{FV=\{x\}}$$

$$\Rightarrow_\beta (\lambda y.xy)$$

Aufgabe 2b

```
g :: Int -> Int -> Int
g a 0 = a
g a b
  | b == 1 = g (a + 1) (b - 1)
  | otherwise = g (a + 2) (b - 2)
```

$$\langle G \rangle = ((\lambda gxy.\langle ite \rangle(\langle iszero \rangle y)$$
$$(\langle ite \rangle(\langle iszero \rangle(\langle pred \rangle y))$$
$$(g(\langle succ \rangle x)(\langle pred \rangle y))$$
$$(g(\langle succ \rangle(\langle succ \rangle x))(\langle pred \rangle(\langle pred \rangle y)))$$
$$))$$