

$$\lambda x. (\underbrace{x \ x}_e)$$

Diagram: A green arrow points from the x in the lambda abstraction to the first x in the body. A red bracket under the $x \ x$ is labeled e . A red $\tilde{v}$ is under the x in the lambda abstraction.

$$(\underbrace{\lambda x. x}_{\tilde{v}} \ x)$$

Diagram: A green arrow points from the x in the lambda abstraction to the x in the body. A red bracket under $\lambda x. x$ is labeled $\tilde{v}$. A red $\tilde{v}$ is under the x in the body.

$$\lambda x. (\underbrace{\lambda x. x \ x}_e)$$

Diagram: A green arrow points from the x in the lambda abstraction to the first x in the body. Another green arrow points from the x in the inner lambda abstraction to the second x in the body. A red bracket under $\lambda x. x \ x$ is labeled e . A red $\tilde{v}$ is under the x in the lambda abstraction. A red $\tilde{v}$ is under the x in the inner lambda abstraction.

$$((\lambda x. \lambda x. x) \ x)$$

Diagram: A green arrow points from the x in the inner lambda abstraction to the x in the body. A red bracket under $\lambda x. \lambda x. x$ is labeled $\tilde{v}$. A red $\tilde{v}$ is under the x in the lambda abstraction. A red $\tilde{v}$ is under the x in the inner lambda abstraction.

$$\xrightarrow{\alpha} ((\lambda y. \lambda x. x \ x) \ x)$$

$$\xrightarrow{\alpha} ((\lambda x. \lambda y. y \ x) \ x)$$

$$v ::= a | b | c | \dots$$

$$e ::= v$$

$$| \lambda v. e$$

$$| (e \ e)$$