

$$\begin{array}{ccccccc}
& & & \ker g & \longrightarrow & Y & \longrightarrow 0 \\
& & & \downarrow & & \downarrow & \\
0 & \longrightarrow & \ker f & \longrightarrow & \bullet & \xrightarrow{f} & \bullet \longrightarrow \operatorname{cok} f \longrightarrow 0 \\
& & \downarrow & & \parallel & & \downarrow \\
0 & \longrightarrow & \ker g \circ f & \longrightarrow & \bullet & \xrightarrow{g \circ f} & \bullet \longrightarrow \operatorname{cok} g \circ f \longrightarrow 0 \\
& & \downarrow & & \downarrow & & \downarrow \\
0 & \longrightarrow & X & \longrightarrow & 0 & \longrightarrow & \operatorname{cok} g \stackrel{\cong}{=} Z
\end{array}$$

Dotted arrows indicate commutativity:

- $\bullet \xrightarrow{f} \bullet \xrightarrow{g \circ f} \bullet$ (middle row)
- $\bullet \xrightarrow{f} \bullet \xrightarrow{g} \bullet$ (middle row)
- $\bullet \xrightarrow{f} \bullet \xrightarrow{g \circ f} \bullet$ (middle row)
- $\bullet \xrightarrow{f} \bullet \xrightarrow{g} \bullet$ (middle row)
- $\bullet \xrightarrow{f} \bullet \xrightarrow{g \circ f} \bullet$ (middle row)
- $\bullet \xrightarrow{f} \bullet \xrightarrow{g} \bullet$ (middle row)

$$0 \longrightarrow \ker f \longrightarrow \ker g \circ f \xrightarrow{X} \ker g \xrightarrow{Y} \operatorname{cok} f \longrightarrow \operatorname{cok} g \circ f \longrightarrow \operatorname{cok} g \longrightarrow 0$$