prove assertion 2, leaving 3 and 4 for the reader to carry out or look up in the references.

Given the solid arrow in the diagram

$$\begin{tikzcd} E_0 \arrow[r] \arrow[d, dashed, "\Phi_0"] & M \arrow[r] \arrow[d, "\varphi"] & 0 \\ F_0 \arrow[r] & N \arrow[r] & 0 \end{tikzcd}$$

the dotted arrow Φ_0 exists by the definition of projective. Proceeding to the next step, if R_0 and S_0 are defined by

$$\begin{tikzcd} 0 \arrow[r] & R_0 \arrow[r] \arrow[d, "\Phi_0"] & E_0 \arrow[r] \arrow[d, "\Phi_0"] & M \arrow[r] \arrow[d, "\varphi"] & 0 \\ 0 \arrow[r] & S_0 \arrow[r] & F_0 \arrow[r] & N \arrow[r] & 0 \end{tikzcd}$$

then what we have is the solid arrows in the diagram

$$\begin{tikzcd} E_1 \arrow[r] \arrow[d, dashed, "\Phi_1"] & R_0 \arrow[r] \arrow[d, "\Phi_0"] & 0 \\ F_1 \arrow[r] & S_0 \arrow[r] & 0 \end{tikzcd}$$

and the dotted arrow fills in by projectivity. Continuing in this manner gives assertion 2. Q.E.D.

$$\begin{tikzcd} E_2 \arrow[r] & E_1 \arrow[r] & E_0 \arrow[r] \arrow[d, dashed, "\Phi_0"] & M \arrow[r] \arrow[d, "\varphi"] & 0 \\ F_2 \arrow[r] & F_1 \arrow[r] & F_0 \arrow[r] & N \arrow[r] & 0 \end{tikzcd}$$