- SETUP: k FIELD
  Q FINITE ACYCLIC
- $i, j \in Q_0$, $\mathrm{Ext}^1_{kQ}(S_i, S_j)$

$\rightsquigarrow$ PROJECTIVE RESOLUTION: $\boxed{0 \to \bigoplus_{\alpha: i \to k} P_k \xrightarrow{(\alpha \cdot -)_\alpha} P_i} \to S_i \to 0$

$$P_i = e_i kQ, \qquad S_i = \frac{e_i kQ}{e_i \cdot R_Q}$$

$\rightsquigarrow$ $\mathrm{Hom}(P_k, S_j) \cong S_j \cdot e_k \cong \begin{cases} k & \cdots\ j = k \\ 0 & \cdots\ j \neq k \end{cases}$

$\rightsquigarrow$
$$0 \leftarrow \mathrm{Ext}^1(S_i, S_j) \xleftarrow{\cong} \mathrm{Hom}\Big(\bigoplus_{\alpha: i \to k} P_k, S_j\Big) \xleftarrow{\overset{!}{0}} \mathrm{Hom}(P_i, S_j)$$
$$\bigoplus_{\alpha: i \to k} S_j \cdot e_k \xleftarrow{(- \cdot \alpha)_\alpha} S_j \cdot e_i$$
$$\bigoplus_{\alpha: i \to j} S_j$$

- $\mathrm{Ext}^1_{KQ}(S_i, S_j)$ IN TERMS OF SHORT EXACT SEQ.:

$$0 \longrightarrow S_j \longrightarrow E \longrightarrow S_i \longrightarrow 0$$

$$\begin{tikzcd}
i \arrow[d, bend right=40, "\alpha_1"'] \arrow[d, "\alpha_2\ \cdots"] \arrow[d, bend left=40, "\alpha_m"] \\
j
\end{tikzcd}
\qquad
\begin{tikzcd}
0 \arrow[r] & 0 \arrow[r] \arrow[d, "0\ 0\ \cdots\ 0"] & K \arrow[r, "1"] \arrow[d, "\lambda_1\ \lambda_2\ \cdots\ \lambda_m"] & K \arrow[r] \arrow[d, "0\ 0\ \cdots\ 0"] & 0 \\
0 \arrow[r] & K \arrow[r, "1"'] & K \arrow[r] & 0 \arrow[r] & 0
\end{tikzcd}$$

$$\mathrm{Ext}^1_{KQ}(S_i, S_j) \cong K^m$$

$$[\text{SEQUENCE FOR } (\lambda_1, \dots, \lambda_m)] \longleftarrow\!\shortmid \quad (\lambda_1, \dots, \lambda_m)$$

QUIVER

UNDERLYING GRAPH

Q :  $\rightsquigarrow$ Γ : 

$$Q = (Q_0, Q_1, s, t) \rightsquigarrow \Gamma = (\Gamma_0, \Gamma_1, \text{ends})$$

$$s, t : Q_1 \longrightarrow Q_0 \qquad \text{ends} : \Gamma_1 \longrightarrow \frac{\Gamma_0 \times \Gamma_0}{\text{flip}}$$