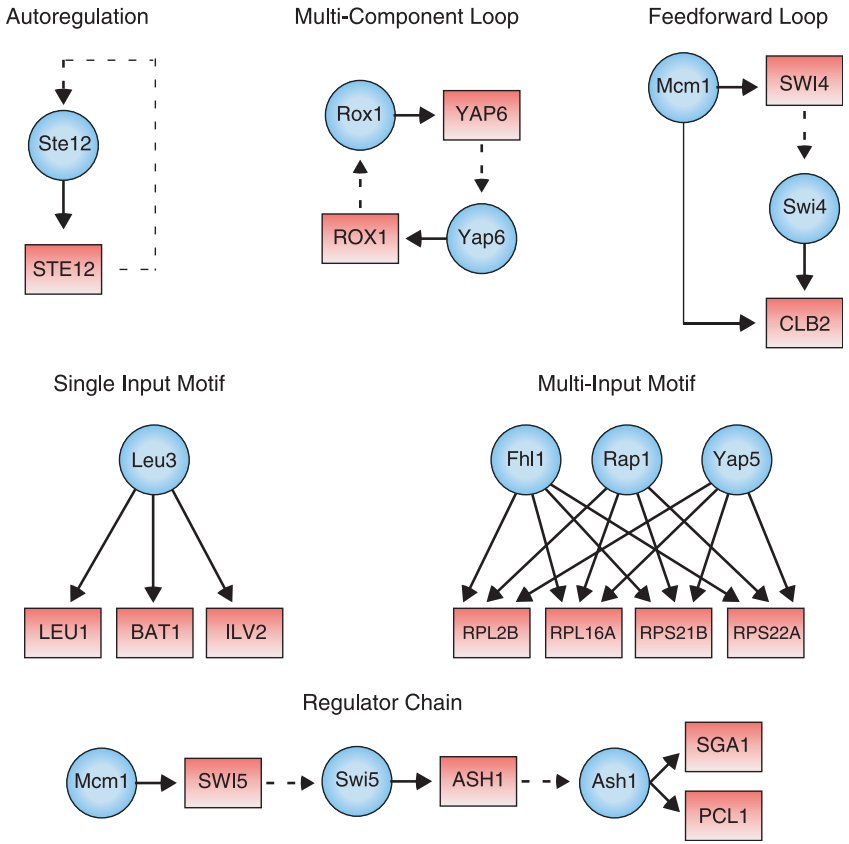
Small-scale subnetworks in Lee et al.

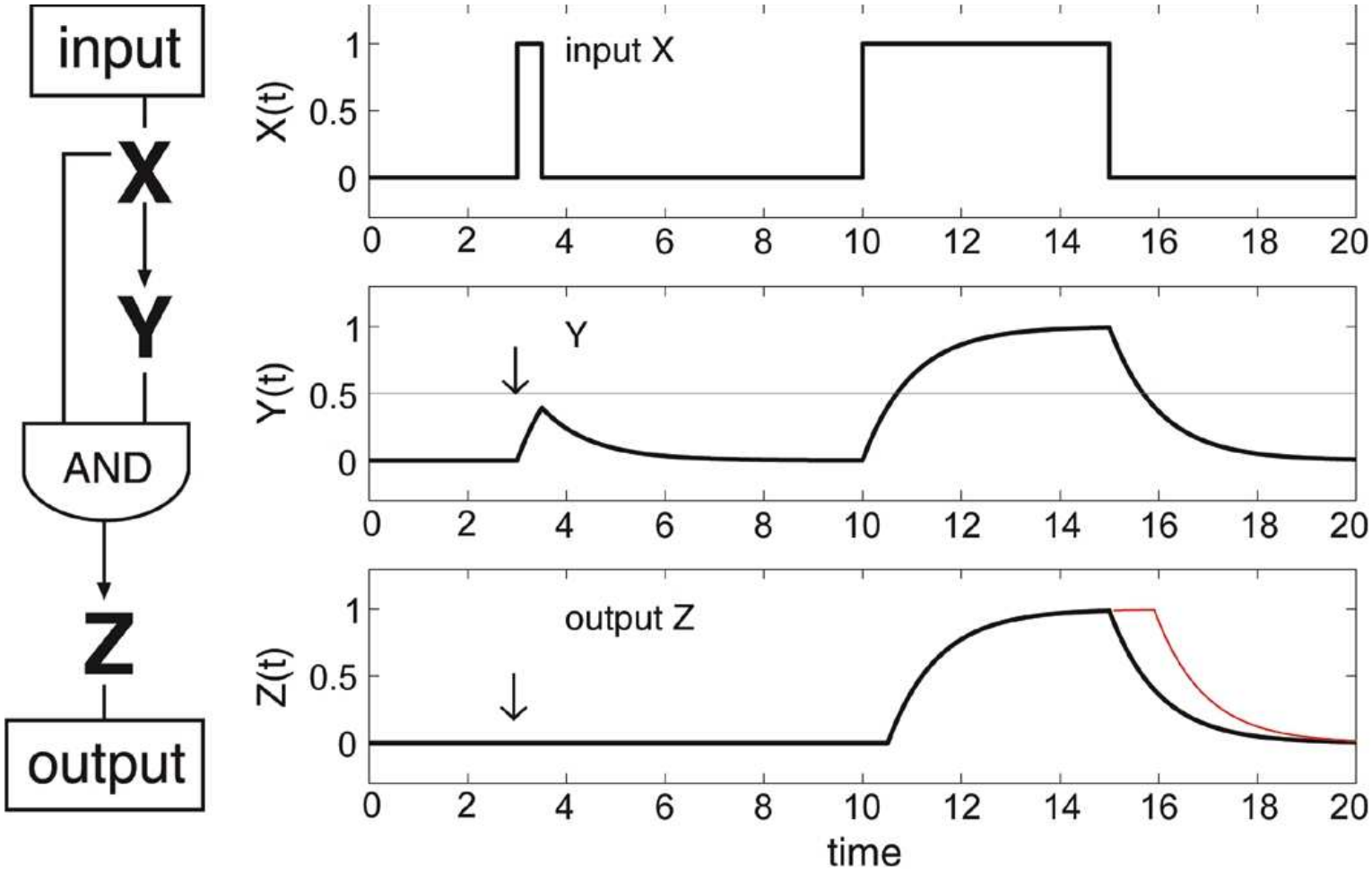
Several types of small-scale subnetworks – network motifs – with interesting functional / dynamical properties were found to be statistically enriched.



What do these motifs do? What are they for?

Function of the feedforward loop

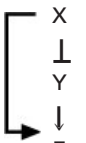
[Shen-Orr *et al.*, 2002]



Function of the feedforward loop

[Mangan & Alon, 2003]

Table 2. Structure and function of the incoherent FFL types, with AND-gates at the Z promoter

	Incoherent type 1		Incoherent type 2		Incoherent type 3		Incoherent type 4	
Species	Structure	Abundance	Structure	Abundance	Structure	Abundance	Structure	Abundance
E. coli		5		0		1		1
S. cerevisiae		21		3		1		0
Z logic →	AND		AND		AND		AND	
Steady-state								
Z(Sx,Sy)	$S_x \wedge \bar{S}_y$		$\bar{S}_x \wedge \bar{S}_y$		0		0	
Pulse								
Sx on step	Weak		—		—		Strong	
Sx off step	—		Weak		Strong		—	
Sy effect	Destroy		Destroy		Enable		Enable	
Response acceleration								
Sx on step	Accelerate		—		—		Accelerate	
Sx off step	—		Accelerate		Accelerate		—	

Incoherent FFL types and their abundance in transcription databases (6, 11). Z(Sx,Sy): Steady-state Z expression of incoherent FFL with no basal level of Y (∨, ¯ represent AND, NOT). Pulse: Response to steps of Sx, in the presence of Sy, in FFLs with no basal activity, Sy effect on pulse: Enable, no pulse is created when Sy is off; Destroy, Z output is a low pulse when Sy is on, but is high and steady when Sy is off (Fig. 3). Response acceleration: Acceleration of response of and steady-state values of incoherent FFL with basal activity to on and off steps in the presence of Sy. —, not accelerated.

Function of the feedforward loop

[Mangan & Alon, 2003]

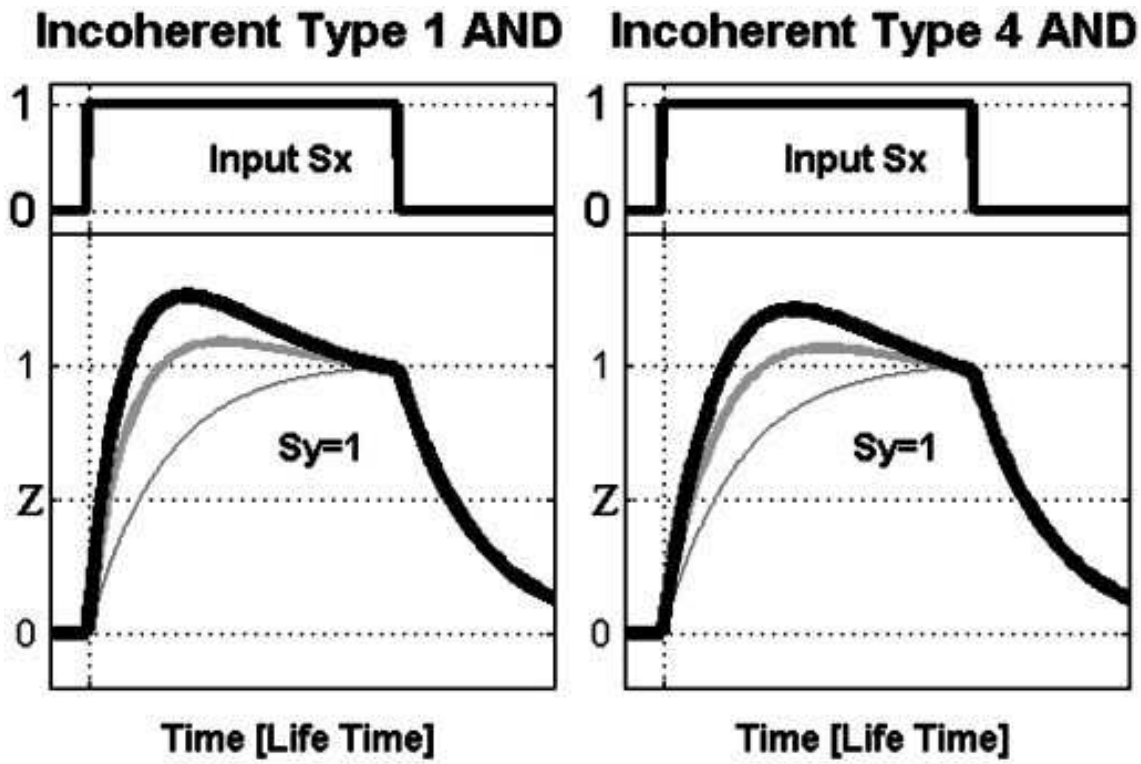


Fig. 4. Kinetics of incoherent type 1 (*Left*) and type 4 (*Right*) FFLs with basal Y activity and AND regulatory logic, in response to on and off steps of Sx. Note that the response of the FFL to on steps (thick, medium lines) is faster than that of a corresponding simple system (thin line). Simulation parameters: for type 1, $K_{xz} = 1$, $K_{xy} = 1$, $K_{yz} = 0.5$, $B_y = \{0.5, 0.3\}$; for type 4, $K_{xz} = 1$, $K_{xy} = 0.1$, $K_{yz} = 0.5$, $B_y = \{0.45, 0.35\}$; all others are as stated in *Materials and Methods*.

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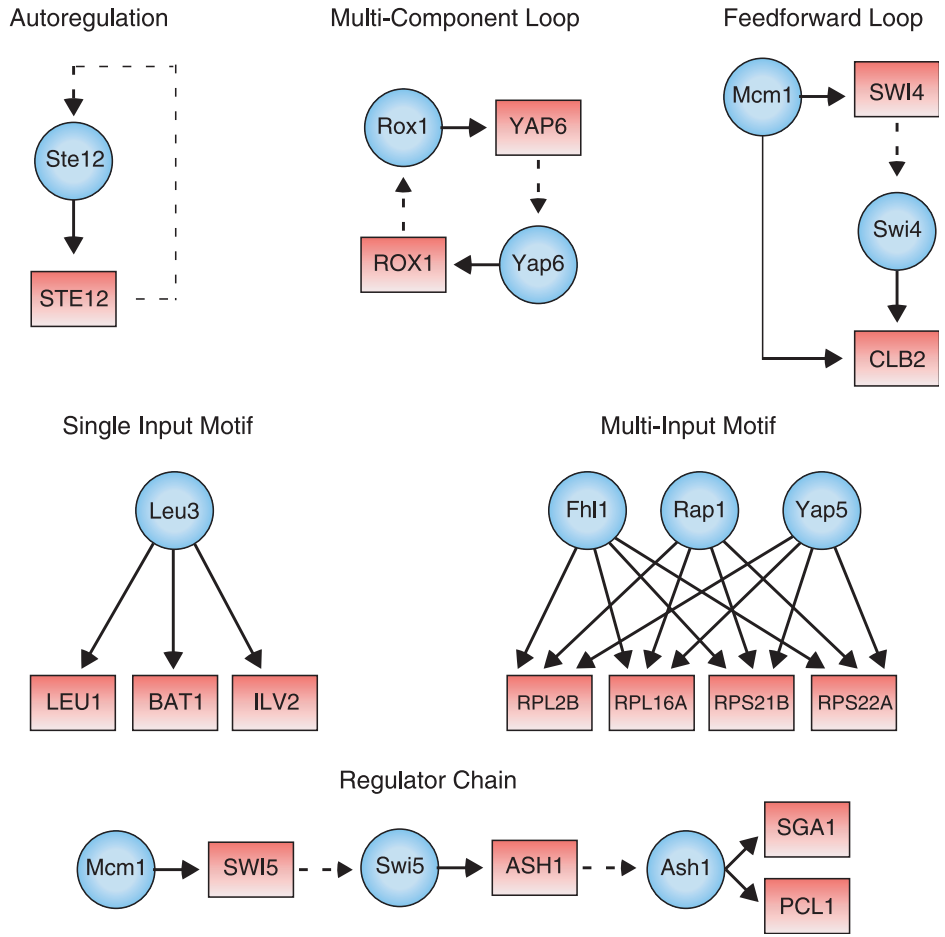

Networks summary

- Networks are represented by *graphs* with *nodes* and *edges*
- At the genome-scale, such graphs are often approximately *scale-free* — the importance of which remains to be seen
- Medium-scale networks hard to identify from graph structure alone—but can be identified by adding expression information
- Small subnetworks, with meaningful dynamics, are apparent