

TSKS11, Fall 2019 - tentative course plan

E. G. Larsson

	Topic	Instructor	Material	Problems	(B=Barabasi; EGL=instructor's problem collection; EK=Easley/Kleinberg)
Seminar	Re-cap of required prerequisites: topics in linear algebra and probability	ZC			
Lecture 1	Introduction to network science. Graph representation of networks. Terminology. Adjacency matrix. Basic metrics. Degree distribution.	EGL	Supplementary notes by EGL. Barabasi Chapters 0, 1, 2. Easley/Kleinberg Chapter 2.	B1.1, B1.2, B1.3, B2.1, B2.2(a)-(d), B2.3(a)-(f), EGL17	
Lecture 2	Clustering coefficients. Bridge and tie theorem. Structural balance. Homophily. Co-citation, bibliometric coupling and projections. Bipartite (affiliation) and tripartite networks.	EGL	Supplementary notes by EGL. Easley/Kleinberg Sections 3.1-3.5, 4.1-4.2, 5.1-5.5	EK3.1, EK3.2, EK3.5, EK4.1, EK5.1, EK5.3, EGL4, EGL12, EGL13, EGL22, EGL34	
Lab 1	Hands-on: Network visualization with Gephi. Introduction to SNAP.	OA, EB, MBR			
Lecture 3	Counting walks. Laplacian. Sampling on networks and friendship paradoxes. Random walks.	EGL	Supplementary notes by EGL.	B2.4, B2.5, B2.6, EGL1, EGL2, EGL3, EGL6, EGL18, EGL19a, EGL35, EGL46	
Tutorial 1	Problems to lectures 1-2.	OA			
Lecture 4	Centrality metrics. Eigenvector centrality, Katz, PageRank, hubs and authorities.	EGL	Supplementary notes by EGL. Easley/Kleinberg Chapters 13-14.	EGL5, EGL7, EGL8, EGL9, EGL23, EGL24, EGL25	
Lecture 5	Poisson random networks. Phase transitions and giant component. Introduction to power-laws and scale-free networks.	EGL	Barabasi Chapter 3, Sec. 4.1-4.2	B3.1, B3.3, B3.5	
Lab 2	Hands-on: Implementing PageRank and Katz centrality.	OA, EB, MBR			
Lecture 6	Power laws and scale-free networks, cont. Preferential attachment and Barabasi-Albert model.	EGL	Barabasi Chapters 4-5 Easley/Kleinberg Chapter 18.	B4.1, B4.2	
Tutorial 2	Problems to lectures 3-4.	OA			
Lecture 7	Information cascades as explanation for copying behavior. Network generation models, degree-preserving randomization and configuration model.	EGL	Barabasi Chapters 4-5 Easley/Kleinberg Chapter 16.	EK18.1, EK18.3, EK16.1, EK16.3, EGL16, EGL30, EGL31	
Lecture 8	Other network growth models. Degree correlation. Structural cutoffs.	EGL	Barabasi Sections 6.1-6.3, 7.1-7.5, 7.7-7.8.	B7.3, EK16.4, EK16.5, EK16.6	
Tutorial 3	Problems to lectures 5-6 + backup time.	OA			
Lecture 9	Small-world phenomena. Watts-Strogatz model. Kleinberg model.	EGL	Easley/Kleinberg Chapter 20.	B3.4, EK20.1, EK20.2, EK20.3, EGL14, EGL15, EGL33	
Lab 3	Hands-on: More network analysis with SNAP and Gephi.	OA, EB, MBR			
Lecture 10	Community detection and partitioning. Kernighan-Lin and Girvan-Newman algorithms. Modularity. Spectral partitioning.	EGL	Barabasi Chapter 9. Supplementary notes by EGL.	B9.3	
Lecture 11	Diffusion and cascades. Linear threshold models. Introduction to deGroot models.	EGL	Easley/Kleinberg Chapter 19. Supplementary notes by EGL.	EGL32, EGL38, EGL44, EGL45, EK19.1, EK19.2, EK19.5, EK19.7	
Lab 4	Hands-on: More network analysis with SNAP and Gephi.	OA, EB, MBR			
Lecture 12	Introduction to link prediction and collaborative filtering with application to recommendation systems.	EGL	Chiang Chapter 4.	none	
Tutorial 4	Problems to lectures 7-8.	OA			
Lab 5	Hands-on: Community detection and partitioning.	OA, EB, MBR			
Tutorial 5	Problems to lectures 9-10.	OA			
Lab 6	Hands-on: Implementing a movie recommendation system.	OA, EB, MBR			
Tutorial 6	Problems to lecture 11 + backup time.	OA			
Lab	backup time + examination	OA, EB, MBR			
Lab	backup time + examination	OA, EB, MBR			
Tutorial 7	Q&A for the exam	OA			