# **Notebook 7/28/18-9/28/19**

51: papers

55: papers

99: Brassica experiment

104: papers

127: Boege talk

141: Edelstein-Keshet & Ermentrout 1989

156: papers: Hoch and Stephenson 1995; Schmitt; Donohue 2000; Lacey; Biere

161: Geber thesis

181: adaptive dynamics vs. quantitative genetics

185: meristem vs. resource limitation

188: Mitchell-Olds 1996

191: papers on apical dominance

# **Notebook 10/1/18-2/18/19**

8: branching metrics

9: Ellison papers on peas and branching

10-18: development project notes, papers

19-20: flowering time notes

28-31: demography and developmental constraint

37: motivation for development/demography/evolution

39-41: trade-offs for composite traits

48-56: quantitative genetic interpretation of branching and growth

63: time course of meristem production

64-65: reproductive allocation and schedules; papers

69: Lehtila and Larsson 2005

71-74: meristems; Lehtila and Larsson 2005 -> defines meristem types

106: reproductive allocation models: Maillette 1982, Fox 1992

107: optimal control theory and development

110-113: brainstorm development models: transition matrices

119-123: brainstorm development functions: allocation functions, trade-offs,

133-134: meristem cycle: Fagerstrom 1992

168: optimal control

171: model in Johansson 2013 and Lindh 2016

174: model in King 1982

179: notes on Wang et al. 2018: description of plant growth

184: Prusinkiewicz 2007

195: Austen and Weiss 2015, Colautti 2017

196: Iwasa

# **Notebook 2/19/19-5/6/19**

1: Schmitt 1993

2: Rubin 2012

4: possible model parameters

6-11: brainstorm model form and parameters

32: dynamic model for growth cf. Prusinkiewicz

79: brainstorm model form

87-90: optim\_fun

91: meet with Steve re: optimization

93-97: optimization troubleshooting

98: brainstorm model form

101-116: Lenhart and Workman

117-121: optimization troubleshooting

122-123: forward-backward sweep

133-136: constrained optimization

145-148: brainstorm model form

150-152: brainstorm model form

154: optimization troubleshooting

156-159: brainstorm model form & expectations

169: discuss Geber 1990 with Monica

176-177: brainstorm model form

181-182: optimization troubleshooting

# **Notebook 5/7/19-9/18/19**

3-6: Meeting with Monica and Steve to discuss models

19-21: model with variation in season length

23-25: troubleshooting how to solve system of ODEs

33-35: troubleshooting how to implement integrand

76-77: notes from Vlastimil Krivan visit

# **Notebook 9/18/19-11/18/19**

58-71: notes on King and Roughgarden 1982

72-73: notes for Kozlowski 1992

93-99: notes for discussing King and Roughgarden 1982 in Ecotheory

100-103: notes on dynamic optimization, Chiang 1992; interpretation of meristem limitation

155: notes on Clark Mathematical Bioeconomics

161: notes on optimal control algorithm

162-165: forms of optimal control

169-173: time discounting in Clark

174: unpublished dissertation with allocation model with herbivores and pollinators

177-180: notes on Murray Optimization Based Control

183: interpret King and Roughgarden with linear inequality constraints

# **Notebook 11/19/19-3/5/20**

75: notes from meeting with Steve on goals

90: notes on Geber book chapter on organ preformation

170: meeting with Steve re: optimization, notes on code

# **Notebook 11/19/19-3/5/20**

7: Park et al. 2012; notes on tomato development

9: notes on Rubin and meristem number and fate

12-14: phenotypic integration, module allometry, module demography

19: identify hypotheses

52: notes on architecture and branching from Whipple

53-55: notes on branching development from Kellogg 2000

56-59: paper notes

60: notes on Fox 1992 optimal control

63: hypotheses about control

64-65: Thornley 1972

69-70: notes on Lehtila and Larsson 2005; hypotheses

73: notes on hypotheses from meeting with Steve

74-75: Itzkovitz 2012

76-79: diagrams of hypotheses and models

80-81: rewrite allocation models from King and Roughgarden 1982

83-85: interpretation of resource and meristem limitation

86-87: develop model

88: notes on meeting with Steve about model development

89: notes on meeting with Monica about model – questions about model form.

90-92: meetings with Steve about model development and interpretation

104-107: notes on L-systems

# **Notebook 6/4/20-7/6/20**

29-32: optimal control reading group

33: model interpretation; meeting with Steve

35-38: notes on Gaoue 206 and optimality

39-41: optimal control reading group

45-6: model equations

49-51: diagram showing division types generating architecture

54: diagrams and plant architecture

56: notes on Coen and Nugent 1994 summarizing how plant divisions generate architecture

58-60: interpretation and connection of model to Prusinkiewicz

# **Notebook 8/6/20-10/12/20**

14: optimal control reading group

16-18: notes on numerical methods for optimization

20-21: encyclopedia definition for optimal control

22-23: empirical examples

24-30: numerical methods for forward-backward sweep and discretize and optimize

30-1: Ratcliffe 1997 development bio

32-4: molecular control of development papers

35: interpretation and hypotheses

35-7: life history context of meristem variation and architecture; hypotheses

39-42: optimal control methods; HJB equation

42-5: empirical examples/conceptual; hypotheses

46-7: forward-backward sweep

49-52: numerical methods; direct multiple shooting

56-9: discussion of Gluzman in optimal control reading group

59: numerical methods

60: discretize and optimize; how does this apply in KR1982 and Mitesser 2007

62-64: notes on numerical optimization

71-6: solve optimal control problem by hand?

77-9: interpretation of Perrin 1992

82-5: notes on numerical optimal control

91-3: notes on White et al. 2016 – interpretation of model

94-7: revisit KR 1982 and interpret

99-104: math from Fox 1992

107: meeting with Steve – interpretation

108-9: model interpretation

112-3: model interpretation

113-9: notes on dynamic programming

120-2: meeting with Steve; notes on model interpretation

123-135: apply Karush-Kuhn Tucker to KR82

138: Lindh 2016

139: papers identifying need to incorporate meristems

140: parameter definitions

153: meeting with Steve; interpretation

179-80: state variable constraints, meeting with Steve

180-1: state variable constraints in optimal control models

191-3: interpretation of marginal values in model

# **Notebook 10/12/20-1/22/21**

3: hypotheses

5-25: paper notes for hypotheses

26-8: meeting with Steve; numerical issues

28-53: analytical solution to Hamiltonian; interpretation of Hamiltonian

55: hypotheses – cf. harper,

60-4: hypotheses, papers;

65-6: meeting with Steve; numerical optimization; suggestion to move back to dynamic programming; graphical interpretation

67: numerical optimization

71-3: discussion about hypotheses with Monica

86: Meeting with Steve; numerical optimization

87-8: interpretation of optimal control

97: meeting with Steve; graphical interpretation

123-4: graphical interpretation

135-6: numerical optimization; resolving penalty for constraint violation

140-2: Ellner lab discussion of Lindh et al. 2016

147: meeting with Steve; numerical optimization

152-3: notes on writing methods

154-5: notes on writing methods and describing numerical optimization

160: writing constraints and penalties in the model; parallelization

163-4: meeting with Anurag about hypotheses

165-7: relate process to hypotheses

168: discuss hypotheses with Monica

171-2: numerical optimization; penalty weight, graphical interpretation

187-191: sensitivity analysis and parameter trajectories

192: state variable vs controls; spurious issues with controls; weak selection on controls

# **Notebook 1/25/21-3/22/21**

11-14: interpretation of constraints

15-6: model without inflorescence meristems

17: analysis of model following Chiang p. 304

18-32: interpretation of constraints, hypotheses

33-6: preparation for EEB talk

42-7: connection to senescence theory

48-50: meeting with Steve, notes on talk, model time scale and interpretation

52: season length distributions

54-5: feedback from Monica on EEB talk

154-5: meeting with Steve and Monica, questions to test, interpretation