

Data and text mining

Shuffle & untangle: novel untangle methods for solving the tanglegram layout problem

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Abstract

Motivation: A tanglegram is a plot of two-tree-like diagrams, one facing the other, and having their labels connected by inter-tree edges. These two trees, which could be both phylogenetic trees and dendrograms stemming from hierarchical clusterings, have thus identically labelled leaves but different topologies. As a result, the inter-tree edges of a tanglegram can be intricately tangled and difficult to be analysed and explained by human readers. To better visualize the tanglegram (and thus compare the two dendrograms) one may try to untangle it, i.e. search for that series of flippings of the various branches of the two trees that minimizes the number of crossings among the inter-tree edges. The untangling problem has received significant interest in the past decade, and several techniques have been proposed to address it. These techniques are computationally efficient but tend to fail at finding the global optimum configuration generating the least tangly tanglegram.

Results: We leverage the existing results to propose untangling methods that are characterized by an overall slower convergence method than the ones in the literature, but that produce tanglegrams with lower entanglements.

Availability and implementation: One of the algorithms is implemented in Python, and available from <https://github.com/schlegelp/tanglegram>.

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1 Introduction

A common strategy to visually compare two different dendrograms relative to the same sets of terminal vertices is by using tanglegrams, i.e. comparative drawings (embeddings) of a pair of dendrograms, side-by-side, with matching objects connected by straight-line segments called inter-tree edges (Andreas *et al.*, 2012). A crossing occurs in a tanglegram when two inter-tree edges intersect, while there is no crossing inside the individual trees. The number of crossings, in its turn, depends on the layout (also known as drawing) of the two dendrograms in the tanglegram. In practical terms, layouts, which lead to a high number of crossings are harder to interpret (Andreas *et al.*, 2012). This calls for finding a drawing of the tanglegram with as few crossings as possible. Finding a tanglegram layout (TL) of two trees that produces zero crossings, sometimes referred to as a drawable layout (Fertus *et al.*, 2010), is known as the planar embedding problem (Andreas *et al.*, 2012). It is known that every pair of trees of size smaller or equal to three has a drawable layout (Fertus *et al.*, 2010). However, only special cases allow for a layout with zero crossings. The problem of finding a graphical layout of

two trees that gives the minimum number of crossings is known as the TL problem (Ramsal *et al.*, 2009), or the two-tree crossing minimization (TTCM) problem (Fertus *et al.*, 2010). The TTCM problem is known to be NP-complete, meaning that there is no known algorithm to solve this problem in polynomial time with the tree size, but only in exponential time (Fertus *et al.*, 2010).

When one tree is fixed, the problem above is referred to as the one-tree crossing minimization (OTCM) (Fertus *et al.*, 2010). For arbitrary trees, the OTCM problem can be solved in $O(n \log n)$ time (with n the number of leaves) as in Venkatasubramanian *et al.* (2009) and Fertus *et al.* (2010). Ramsal *et al.* (2009), instead, presented an $O(n \log^2 n / \log \log n)$ algorithm for a generalized tanglegram.

A heuristics-based algorithm to tackle the TTCM problem was proposed in Dwyer and Schreiber (2004). Here, the authors repeatedly solve the OTCM problem for each tree, and eventually provide 2.5D graphical representations of the results. Another approximation algorithm for complete tanglegrams is provided in Buchin *et al.* (2009).

The TTCM for binary trees problem was shown in Fertus *et al.* (2010) to be fixed parameter tractable (FPT) with parameter k (the

Untangle A Novel

Shenshen Cai



Untangle A Novel:

Canaan: A Novel Donald McCaig, 2008-02-17 A bred in the bones storyteller Geraldine Brooks Canaan fills a vast canvas Its points of reference are Richmond in the throes of Reconstruction the trading floors of Wall Street a Virginia plantation and the Great Plains where the splendidly arrogant George Custer Yellowhair rides to his fate against Sitting Bull s warriors This is the story of America over twenty years of its most turbulent history The characters are black white and red ex Union and ex Confederate and the principal narrator is a Santee woman She Goes Before who marries an ex slave Through her eyes we witness the hanging of her father by whites in the mass execution of 1863 Red Cloud s banquet with President Grant and that final confrontation on the bluffs above the Little Bighorn Northanger Abbey - Second Edition Jane Austen, 2002-04-29 First accepted by a publisher in 1803 Northanger Abbey was eventually published posthumously in 1818 In it Austen weaves a romance full of suspense and comedy around the heroine Catherine Morland s first foray into society The style of the novel is a unique hybrid along the way Austen parodies the eighteenth century novel of manners the Gothic novel and even the educational treatises of the time The second Broadview edition includes a revised introduction notes bibliography and expanded appendices of background contextual materials *Novel Ideas* Barbara Shoup, Margaret-Love Denman, 2013-05-01 Novel Ideas provides a substantial introduction to the elements of fiction followed by in depth interviews with successful novelists who speak with candor and insight into the complex process by which a novel is made This edition includes new and updated interviews as well as writing exercises to enhance its use in the writing classroom Dorothy Allison recalls deliciously self indulgent days of writing in her bathrobe wrapped in misery and exultation Peter Cameron explains how he made the move from short fiction to the novel with the aid of a music composer s notebook to track the movement of his characters Writers as different as Ha Jin Jill McCorkle Richard Ford and Michael Chabon describe their unique approaches to their work while consistently affirming the necessity of committing to the hard effort of it while also remaining open to surprise Aspiring novelists will find hands on strategies for beginning working through and revising a novel accomplished novelists will discover new ways to solve the problems they face in process and serious readers of contemporary fiction will enjoy a glimpse into the way novels are made Includes interviews with Dorothy Allison Larry Brown Peter Cameron Michael Chabon Michael Cunningham Robb Forman Dew Richard Ford Ha Jin Patricia Henley Charles Johnson Wally Lamb Valerie Martin Jill McCorkle Sena Jeter Naslund Lewis Nordan Sheri Reynolds S J Rozan Jane Smiley Lee Smith Theodore Weesner *Hybrid Novels* George Kowalik, 2025-10-03 The phrase post postmodernism has appeared in Contemporary Literary Studies since the 20th century but what does it mean Scholars have defined the term in various often contradictory ways Existing studies also rarely centralise race an essential component in the transition from postmodern irony to post postmodern sincerity Hybrid Novels analyses post postmodernism s only consistency and certainty hybridity This speaks for a broader social issue concerning the ethics of categorisation and the conflicting labels imposed on subjectivity Hybrid Novels

considers landmark American British novels by Percival Everett Jonathan Franzen Zadie Smith and David Foster Wallace published from 1996 to 2001 It positions these authors at the centre of the post postmodernism debate together for the first time This book suggests that 2010s autofiction further develops post postmodern tensions of irony and sincerity at the turn of the 21st century Major American Canadian novels by Sheila Heti Ben Lerner Teju Cole and Tao Lin are discussed published from 2010 to 2013 *Rewriting Wrongs* Angela Kimyongür, Amy Wigelsworth, 2014-10-02 *Rewriting Wrongs* French Crime Fiction and the Palimpsest furthers scholarly research into French crime fiction and within that broad context examines the nature functions and specificity of the palimpsest Originally a palaeographic phenomenon the palimpsest has evolved into a figurative notion used to define any cultural artefact which has been reused but still bears traces of its earlier form In her 2007 study *The Palimpsest* Sarah Dillon refers to the persistent fascination with palimpsests in the popular imagination embodying as they do the mystery of the secret the miracle of resurrection and the thrill of detective discovery In the context of crime fiction the palimpsest is a particularly fertile metaphor Because the practice of rewriting is so central to popular fiction as a whole crime fiction is replete with hypertextual transformations The palimpsest also has tremendous extradiegetic resonance in that crime fiction frequently involves the rewriting of criminal or historical events and scandals This collection of essays therefore exemplifies and interrogates the various manifestations and implications of the palimpsest in French crime fiction *Rogue One Junior Novel* Lucasfilm Press, 2016-12-16 An official novelization of *Rogue One* A Star Wars Story follows a band of rebels on a daring mission to steal the Death Star plans *Domestic Modernism, the Interwar Novel, and E.H. Young* Chiara Briganti, Kathy Mezei, 2016-12-05 *Domestic Modernism the Interwar Novel and E H Young* provides a valuable analytical model for reading a large body of modernist works by women who have suffered not only from a lack of critical attention but from the assumption that experimental modernist techniques are the only expression of the modern In the process of documenting the publication and reception history of E H Young's novels the authors suggest a paradigm for analyzing the situation of women writers during the interwar years Their discussion of Young in the context of both canonical and noncanonical writers challenges the generic label and literary status of the domestic novel as well as facile assumptions about popular and middlebrow fiction canon formation aesthetic value and modernity The authors also make a significant contribution to discussions of the everyday and to the burgeoning field of homeculture as they show that the fictional embodiment and inscription of home by writers such as Young Virginia Woolf Elizabeth Bowen Ivy Compton Burnett Lettice Cooper E M Delafield Stella Gibbons Storm Jameson and E Arnot Robertson epitomize the long standing symbiosis between architecture and literature or more specifically between the house and the novel *The Cambridge Companion to American Science Fiction* Gerry Canavan, Eric Carl Link, 2015-01-26 *The Cambridge Companion to American Science Fiction* explores the relationship between the ideas and themes of American science fiction and their roots in the American cultural experience Science fiction in America has long served to reflect the country's hopes desires ambitions and

fears The ideas and conventions associated with science fiction are pervasive throughout American film and television comics and visual arts games and gaming and fandom as well as across the culture writ large Through essays that address not only the history of science fiction in America but also the influence and significance of American science fiction throughout media and fan culture this companion serves as a key resource for scholars teachers students and fans of science fiction **The Cambridge Companion to the Graphic Novel** Stephen E. Tabachnick, 2017-07-03 Since the graphic novel rose to prominence half a century ago it has become one of the fastest growing literary artistic genres generating interest from readers globally The Cambridge Companion to the Graphic Novel examines the evolution of comic books into graphic novels and the distinct development of this art form both in America and around the world This Companion also explores the diverse subgenres often associated with it such as journalism fiction historical fiction autobiography biography science fiction and fantasy Leading scholars offer insights into graphic novel adaptations of prose works and the adaptation of graphic novels to films analyses of outstanding graphic novels like *Maus* and *The Walking Man* an overview which distinguishes the international graphic novel from its American counterpart and analyses of how the form works and what it teaches making this book a key resource for scholars graduate students and undergraduate students alike The Diachrony of Ditransitives in Late Modern Swedish Fredrik Valdeson, 2024-06-11 This book presents the first major study of ditransitives in Swedish Using a combination of well established and innovative corpus based methods the book reveals considerable changes in the constructional behaviour of ditransitive verbs over the course of the last 200 years The key finding is that the use of the so called double object construction has decreased dramatically in terms of frequency lexical richness and semantic range This development is paralleled by a decisive increase in prepositional object constructions The results are of high relevance to the ongoing debate within construction grammar on constructional productivity and on the nature of horizontal links

Television Drama in Contemporary China Shenshen Cai, 2016-09-13 Due to high audience numbers and the significant influence upon the opinions and values of viewers the political leadership in China attributes great importance to the impact of television dramas Many successful TV serials have served as useful conduits to disseminate official rhetoric and mainstream ideology and they also offer a rich area of research by providing insight into the changing Chinese political social and cultural context This book examines a group of recently released TV drama serials in China which focus upon and to various degrees represent topical political social and cultural phenomena Some of the selected TV serials reflect the present ideological proclivities of the Chinese government whilst others mirror social and cultural occurrences or provide coded and thought provoking messages on China's socio economic and political reality Through in depth textual analysis of the plots scenes and characters of these selected TV serials the book provides timely interpretations of contemporary Chinese society its political inclinations social fashions and cultural tendencies The book also demonstrates how popular media narratives of TV drama serials engage with sensitive civic issues and cultural phenomena of modern day China which in turn encourages a

broader social imagination and potential for change Advancing our understanding of contemporary China this book will appeal to students and scholars of contemporary Chinese culture society and politics as well as those with research interests in television studies more generally Mexico in Its Novel John S. Brushwood,2014-06-23 Mexico in Its Novel is a perceptive examination of the Mexican reality as revealed through the nation s novel The author presents the Mexican novel as a cultural phenomenon a manifestation of the impact of history upon the nation an attempt by a people to come to grips with and understand what has happened and is happening to them Written in a clear and graceful style this study examines the life of the novel as a genre against the background of Mexican chronology It begins with a survey of the mid twentieth century novel the Mexican novel which came of age in the period following the 1947 publication of Agust n Y ez s *The Edge of the Storm* During this time the novel resolved some of its most complicated problems and as a result offered a wider and deeper view of reality Having established this circumstance John Brushwood goes back in time to the Conquest and then moves forward to the twentieth century novel Passing from the Colonial Period into the nineteenth century the author recognizes the relationship between Romanticism and the desire for logical social behavior and then views this relationship in the perspective of the Reform an attempt to bring order out of chaos The novel under the D az dictatorship is seen in three different phases and the last D az chapter actually moves into the Revolution itself The novel during the years of fighting is considered along with the first post Revolutionary fiction From that point the developing conflict within Mexican reality itself a conflict between introversion and extroversion nationalism and cosmopolitanism reaches out to seek its solution in the novels of the first chapter **Love, Love, Love (Three contemporary romance novels: Falling Fast - Seattle Girl - Sparks Fly)** Lucy Kevin,2014-01-01 Fans of Sophie Kinsella Meg Cabot Nora Roberts SEATTLE GIRL Chick lit about love dating and my really big mouth SPARKS FLY A romance about the magic of falling in love David Foster Wallace: Fiction and Form David Hering,2016-09-08 A fresh reassessment of David Foster Wallace s entire fictional career and writing process **Encyclopedia of the Vampire** S. T. Joshi,2010-11-04 An exhaustive work covering the full range of topics relating to vampires including literature film and television and folklore Encyclopedia of the Vampire The Living Dead in Myth Legend and Popular Culture is a comprehensive encyclopedia relating to all phases of vampirism in literature film and television in folklore and in world culture Although previous encyclopedias have attempted to chart this terrain no prior work contains the depth of information the breadth of scope and the up to date coverage of this volume With contributions from many leading critics of horror and supernatural literature and media the encyclopedia offers entries on leading authors of vampire literature Bram Stoker Anne Rice Stephenie Meyer on important individual literary works Dracula and Interview with the Vampire on celebrated vampire films the many different adaptations of Dracula the Twilight series Love at First Bite and on television shows Buffy the Vampire Slayer and Angel It also covers other significant topics pertaining to vampires such as vampires in world folklore humorous vampire films and vampire lifestyle The American Novel of Manners Helen

Gertrude Bannan,1915 **The Blackwell Companion to Jesus** Delbert Burkett,2013-11-11 The Blackwell Companion to Jesus features a comprehensive collection of essays that explore the diverse ways in which Jesus has been imagined or portrayed from the beginnings of Christianity to the present day Considers portrayals of Jesus in the New Testament and beyond Jesus in non Christian religions philosophical and historic perspectives modern manifestations and representations in Christian art novels and film Comprehensive scope of coverage distinguishes this work from similar offerings Examines both Christian and non Christian perspectives on Jesus including those from ethnic and sexual groups as well as from other faiths Offers rich and rewarding insights which will shape our understanding of this influential figure and his enduring legacy

Routledge International Handbook of Irish Studies Renée Fox,Mike Cronin,Brian Ó Conchubhair,2020-12-30 Routledge International Handbook of Irish Studies begins with the reversal in Irish fortunes after the 2008 global economic crash The chapters included address not only changes in post Celtic Tiger Ireland but also changes in disciplinary approaches to Irish Studies that the last decade of political economic and cultural unrest have stimulated Since 2008 Irish Studies has been directly and indirectly influenced by the crash and its reverberations through the economy political landscape and social framework of Ireland and beyond Approaching Irish pasts presents and futures through interdisciplinary and theoretically capacious lenses the chapters in this volume reflect the myriad ways Irish Studies has responded to the economic precarity in the Republic renewed instability in the North the complex European politics of Brexit global climate and pandemic crises and the intense social change in Ireland catalyzed by all of these Just as Irish society has had to dramatically reconceive its economic and global identity after the crash Irish Studies has had to shift its theoretical modes and its objects of analysis in order to keep pace with these changes and upheavals This book captures the dynamic ways the discipline has evolved since 2008 exploring how the age of austerity and renewal has transformed both Ireland and scholarly approaches to understanding Ireland It will appeal to students and scholars of Irish studies sociology cultural studies history literature economics and political science Chapter 3 5 and 15 of this book is available for free in PDF format as Open Access from the individual product page at www.routledge.com It has been made available under a Creative Commons Attribution Non

Commercial No Derivatives 4 0 license Philip Roth through the Lens of Kepesh Paul McDonald,Samantha Roden,2016-05-31 The Kepesh trilogy spans three decades of Philip Roth s career beginning with *The Breast* in 1972 and continuing with *The Professor of Desire* in 1977 and *The Dying Animal* in 2001 This study demonstrates that the trilogy is not only worthy of critical analysis in its own right but also that an appreciation of its themes and strategies deepens our understanding of his entire fictional enterprise offering an invaluable perspective on one of the world s most important novelists Paul McDonald works at the University of Wolverhampton where he is Senior Lecturer in American Literature and Course Leader for Creative Writing Among his other HEB titles are *The Philosophy of Humour* 2012 and *Reading Beloved* 2014 Samantha Roden is a Lead Practitioner for English at North East Wolverhampton Academy She writes educational

resources digital pedagogical guides and conducts national webinars for Cambridge University Press Her first full collection of poetry *Catch Ourselves in Glass* is forthcoming *Tragic Novels, René Girard and the American Dream* Carly Osborn, 2020-05-14 This book draws on the philosopher René Girard to argue that three twentieth century American novels Jeffrey Eugenides's *The Virgin Suicides* Rick Moody's *The Ice Storm* and Richard Yates's *Revolutionary Road* are tragedies Until now Girardian literary analysis has generally focused on representations of human desire in texts and neglected both other emotions and the place of tragedy Carly Osborn addresses these omissions by using Girardian theory to present evidence that novels can indeed be tragedies The book advances the scholarship of tragedy that has run from Aristotle to Nietzsche to Terry Eagleton proposing a new way to read modern novels through ancient traditions In addition this is the first work to examine the place of women as victims or in Girardian terms scapegoats in twentieth century fiction specifically by considering the representation of women's bodies and ambivalence about their identities In deploying a rich and vivid array of tragic tropes *The Virgin Suicides* *The Ice Storm* and *Revolutionary Road* participate in a deep rooted American tragic tradition *Tragic Novels the American Dream and René Girard* will be of interest to those working at the intersection of philosophy and literature as well as Girard specialists

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