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Artificial intelligence in architecture: Generating conceptual design via deep learning	International Journal of Architectural Computing	Article Information Volume: 16 issue: 4, page(s): 306-327 Article first published online: November 28, 2018; Issue published: December 1, 2018 Imdat As1, Siddharth Pal2, Prithwish Basu2 1Department of Architecture, University of Hartford, West Hartford, CT, USA 2Raytheon BBN Technologies, Cambridge, MA, USA Corresponding Author: Imdat As, Department of Architecture, University of Hartford, 200 Bloomfield Avenue, West Hartford, CT 06117, USA. Email: as@hartford.edu	Abstract Artificial intelligence, and in particular machine learning, is a fast-emerging field. Research on artificial intelligence focuses mainly on image-, text- and voice-based applications, leading to breakthrough developments in self-driving cars, voice recognition algorithms and recommendation systems. In this article, we present the research of an alternative graph-based machine learning system that deals with three-dimensional space, which is more structured and combinatorial than images, text or voice. Specifically, we present a function-driven deep learning approach to generate conceptual design. We trained and used deep neural networks to evaluate existing designs encoded as graphs, extract significant building blocks as subgraphs and merge them into new compositions. Finally, we explored the application of generative adversarial networks to generate entirely new and unique designs. Keywords Architectural design, conceptual design, deep learning, artificial intelligence, generative design
Digital Fabrication - From Tool to a Way of Thinking - Toward redefining architectural design methodology	CAADRIA	Silva, Daniela year 2019 M. Haeusler, M. A. Schnabel, T. Fukuda (eds.), Intelligent & Informed - Proceedings of the 24th CAADRIA Conference - Volume 2, Victoria University of Wellington, Wellington, New Zealand, 15-18 April 2019, pp. 463-470	Abstract The digital design appears as an integrated process from conceptualization to materialization and fabrication. The main question is: How the new medium changed the workflow in architecture from a linear model to a cyclic model and the role of new materialization as a form of design thinking? This paper is part of a study that investigates the architectural design process and starts from the premise that we should expand the study of design methods to include other approaches. It considers digital fabrication not as a tool, but as an integrated strategy in collaborative digital processes that can allow a better communication along the design process. It presents the development of design methodologies in order to contribute to a greater understanding of the methodology for design projects with caution to the fact that each one reflects the period in which it was developed. keywords : Digital Fabrication; Computational design; Architectural design
A review of making in the context of digital fabrication tools	L. Corsini and J. Moultrie	INTERNATIONAL DESIGN CONFERENCE - DESIGN 2018 https://doi.org/10.21278/idc.2018.0242	Abstract The review considers the role of making in the context of digital fabrication tools. Digital fabrication is having significant impacts on design and is challenging traditional production paradigms. The study reviews literature on making to conceptualise the activity of design-in-making, where making becomes an integral part of the design process. The paper analyses an improvisational model of design to suggest practical ways to achieve improvisational making when using digital fabrication, with the goal of achieving creative design. Keywords: digital design, digital manufacturing, design creativity, design process, design theory
Glyphs		http://acadia.org/projects/KEPAN2	DESCRIPTION This set of drawings explores the overlap between procedural design processes and conventional techniques of architectural representation. The project navigates the ambiguous forms of agency

			that emerge through algorithmic and automatic design processes of generating form. It also explores parametric modes of representation as part of the generative process. The forms are output in a series of two-dimensional and flattened three-dimensional axonometric drawings. Representational processes of projection and casting shadows yield an abstraction of these forms into a new, strange language of figural shapes.
A Graph Theoretical Approach for Creating Building Floor Plans	Krishnendra ShekhawatKrishnendra ShekhawatPinki YdPinki YdJose DuarteJose Duarte	May 2019 DOI: 10.1007/978-981-13-8410-3_1 In book: Computer-Aided Architectural Design. "Hello, Culture" Project: Automated Generation of Dimensioned Floor Plans	Abstract Existing floor planning algorithms are mostly limited to rectangular room geometries. This restriction is a significant reason why they are not used much in design practice. To address this issue, we propose an algorithm (based on graph theoretic tools) that generates rectangular and, if required, orthogonal floor plans while satisfying the given adjacency requirements. If a floor plan does not exist for the given adjacency requirements, we introduce circulations within a floor plan to have a required floor plan.
Customization and generation of floor plans based on graph transformations	Xiao-YuWangaYinYangbKangZhanga	https://doi.org/10.1016/j.autcon.2018.07.017 Automation in Construction	Abstract This paper introduces an approach for automatic generation of rectangular floor plans based on existing legacy floor plans with the capability of further improvement and customization. Our approach first derives a dual graph from the given input file specifying a floor plan. It then either automatically reproduces varied floor plans retaining the connectivity of the original plan or performs transformation rules to manipulate spatial relations among rooms, and to generate modified floor plans corresponding to specific requirements. Our approach introduces constraints, such as the maximum width-height ratio, to support the flexibility for various design requirements. A graphical user interface is provided for users to perform the automatic generation process. An experiment has been conducted to validate the feasibility of our approach and time taken in generating floor plans. It shows that our method is able to generate highly-customized floor plans in reasonable time. Keywords Floor planning Modeling Rectangular dual CAD Highlights •A Graph Approach to Design Generation, or GADG, that automatically generates controllable and tractable floor plans. •Transformation rules, including addition and subtraction rule, are provided for to allow designers to modify floor plans. •A linear rectangular dual checking and finding algorithm is introduced to automatically generate rectangular floor plans. •Parameterizable GADG capable of generating customizable results to suit a wide range of real-world requirements. •A case study is described step-by-step for generating floor plans with specific design requirements.
Enumerating generic	KrishnendraShekhawat	Automation in Construction 2019	Abstract

rectangular floor plans			A rectangular floor plan (RFP) is a floor plan in which plan's boundary and each room is a rectangle. The problem is to construct a RFP for the given adjacency requirements, if it exists. In this paper, we aim to present a generic solution to the above problem by enumerating a set of RFP that topologically contain all possible RFP. This set of RFP is called generic rectangular floor plans (GRFP). Furthermore, the construction of GRFP leads us to the necessary condition for the existence of a RFP corresponding to a given graph. Highlights •Mathematically, we describe and enumerate generic rectangular floor plans (GRFP). •GRFP stands for a set of rectangular floor plans (RFP) that topologically contain all possible RFP. •From GRFP, any existing RFP and its isomorphic RFP can be derived. •GRFP leads to a class of RFP that is independent of adjacency constraints.
Clustering of architectural floor plans: A comparison of shape representations	EugénioRodriguesaDavidSousa-RodriguesbMafaldaTeixeira de SampayocAdélio RodriguesGaspardÁlvaroGomeseCarlosHenggeler Antunese	Automation in Construction 2017	Abstract Generative design methods are able to produce a large number of potential solutions of architectural floor plans, which may be overwhelming for the decision-maker to cope with. Therefore, it is important to develop tools which organise the generated data in a meaningful manner. In this study, a comparative analysis of four architectural shape representations for the task of unsupervised clustering is presented. Three of the four shape representations are the Point Distance, Turning Function, and Grid-Based model approaches, which are based on known descriptors. The fourth proposed representation, Tangent Distance, calculates the distances of the contour's tangents to the shape's geometric centre. A hierarchical agglomerative clustering algorithm is used to cluster a synthetic dataset of 72 floor plans. When compared to a reference clustering, despite good perceptual results with the use of the Point Distance and Turning Function representations, the Tangent Distance descriptor (Rand index of 0.873) provides the best results. The Grid-Based descriptor presents the worst results. Highlights •An unsupervised clustering of architectural floor plans is carried out. •Four shape representations are perceptually analysed. •A new descriptor is presented that is based on Tangent Distance to shapes centre. •Perimeter-based descriptors presented the best results.
Hybrid Evolutionary Algorithm applied to Automated Floor Plan Generation	International Journal of Architectural Computing	, Paweł B. Myszkowski First Published March 13, 2019 Research Article https://doi.org/10.1177/1478077119832982	Abstract The article presents the application of Hybrid Evolutionary and Greedy-based algorithms to the problem of Automated Floor Plan Generation. The described optimization issue is part of a wider domain of Computer-Aided Architectural Design. The article covers the extensive description of the representation domain model (architectural canonical guidelines, user design requirements and constraints) and the explanation of proposed approach: problem representation, genetic algorithm operators, and fitness function definition. The research experimental procedures are based on real-world data: the architectural design guidelines being the design constraints and five real-world functional programs introduced and proposed as benchmarks. The article summarizes the implementation of the proposed approach, compares the Hybrid Evolutionary Algorithm experimental results with the Greedy-based algorithm, and suggests possible extensions and future research directions. Keywords Computer-Aided Architectural Design, optimization in CAAD, Automated Floor Plan Generation, Hybrid Evolutionary Algorithm, optimization, benchmark

Topological interlocking in architecture: A new design method and computational tool for designing building floors	International Journal of Architectural Computing	Michael Weizmann, Oded Amir, Yasha Jacob Grobman First Published July 28, 2017 Research Article https://doi.org/10.1177/1478077117714913	Abstract This article presents a framework for the design process of structural systems based on the notion of topological interlocking. A new design method and a computational tool for generating valid architectural topological interlocking geometries are discussed. In the heart of the method are an algorithm for automatically generating valid two-dimensional patterns and a set of procedures for creating several types of volumetric blocks based on the two-dimensional patterns. Additionally, the computational tool can convert custom sets of closed planar curves into structural elements based on the topological interlocking principle. The method is examined in a case study of a building floor. The article concludes with discussions on the potential advantages of using the method for architectural design, as well as on challenging aspects of further development of this method toward implementation in practice. Keywords Parametric design, topological interlocking, form generation, structural floor system