15th Chico Topology Conference
Titles and Abstracts
(As of April 6, 2016)

Invited Speakers

Speaker: **Vincent Bouchard**, University of Alberta
Title: From Strings to Knots, via Topological Recursion

Abstract: Knot invariants are useful for determining whether two knots can be transformed into each other. Many different constructions of knot invariants exist, and some of them are conjectured to satisfy highly non-trivial relations, such as in the well-known AJ-conjecture relating the Jones polynomial to the A-polynomial. It turns out that knot invariants also appear in string theory. In this talk I will explain what string theory may have to say about certain knot invariants. I will focus on the recently discovered topological recursion in string theory, which may give rise to unexpected structural properties for certain knot invariants and shed light on connections such as the AJ-conjecture and its generalizations.

Speaker: **Charles Hagopian**, CSU, Sacramento
Title: 50 Years of Continuum Theory — A Selection of Results and Unsolved Problems

Abstract: Over the past 50 years, my focus shifted from various forms of aposyndesis, to arcwise connectivity, to the plane fixed-point problem, to homogeneity, and then back to fixed-point problems. I saw many outstanding results and was inspired by related questions. I will recall some of these results and list some still unsolved problems.

Recently Mark Marsh and I obtained some partial answers to the following open fundamental question of Rudy Gordh.
If M is a continuum that admits a map to arc and each point preimage is either a point or an arc, must M have the fixed-point property?
The answer is yes if M is 1-dimensional or planar. It would be interesting to know if M must be embeddable in Euclidean 3-Space.

Speaker: **Logan Hoehn**, Nipissing University
Title: A complete classification of homogeneous compact spaces in the plane

Abstract: A space X is homogeneous if for every pair of points in X, there is a homeomorphism of X to itself taking one point to the other. This concept was first introduced by Sierpinski, and in 1920 Knaster and Kuratowski asked whether the circle is the only homogeneous compact connected space (continuum) in the plane consisting of more than one point. Explorations of this problem fueled a significant amount of research in continuum theory, and among other things, led to the discovery of two new homogeneous spaces in the plane: the pseudo-arc and the circle of pseudo-arcs. I will present some of the history of work in this area, and describe our recent result which implies that there are no more undiscovered homogeneous compact spaces in the plane. This is joint work with Lex G. Oversteegen.

Speaker: **Emille Davie Lawrence**, University of San Francisco
Title: Topological symmetry groups of Möbius ladders

Abstract: Chemists have been trying for decades to synthesize molecules with topologically interesting structures. This served as motivation for the study of symmetries of graphs embedded in S^3. Furthermore, the questions arising from chemists have led to answers that are topologically fascinating in their own right. We will define the topological symmetry group of a graph embedded in S^3, and discuss recent work on exactly what groups are realizable as topological symmetry groups for a certain class of graphs known as Möbius ladders.

Speaker: **Anastasiia Tsvietkova**, UC, Davis
Title: The number of surfaces of fixed genus in an alternating link complement

Abstract: An incompressible surface in a 3-dimensional manifold is, in intuitive terms, a surface which is simplified as much as possible while remaining nontrivial in the manifold. The presence of such surfaces can give information about the 3-manifold, and is an interesting question in its own right.

Let our 3-manifold M be the complement of a prime alternating link with n crossings in a 3-sphere. We show that the number of genus-g incompressible surfaces in M is bounded by a polynomial in n. Previous bounds were exponential in n. This is joint work with Joel Hass and Abby Thompson.

Contributed Talks

Speaker: **Rick Danner**, CSU, Chico
Title: Modular Curves as Riemann Surfaces

Abstract: We consider the well known action of finite index subgroups Γ of the linear fractional transformations $SL_2(\mathbb{Z})$ on the upper half plane $\mathfrak{H}$. We will show that $Y(\Gamma) = \Gamma\backslash\mathfrak{H}$ is a non-compact Riemann Surface. One can compactify this Riemann Surface by considering this actions extension to the upper half plane $\mathfrak{H}^\star$ including the rational points of the real line and ∞ on its boundary, namely $\mathbb{P}^1(\mathbb{Q})$. Then $X(\Gamma) = \Gamma\backslash\mathfrak{H}^\star$ is a compact Riemann Surface.
In case $\Gamma = SL_2(\mathbb{Z})$, Γ acts transitively on $\mathbb{P}^1(\mathbb{Q})$ leaving one "cusp" which is the orbit $\Gamma\infty$. But if Γ is a finite index subgroup of $SL_2(\mathbb{Z})$ then Γ partitions $\mathbb{P}^1(\mathbb{Q})$ into finitely many orbits leaving multiple holes in the surface. Compactifying $Y(\Gamma)$ involves adding finitely many points (the orbits). We will define charts on $X(\Gamma)$ which include the cusps to demonstrate the conclusion.
Time permitting we will discuss the functions on these surfaces known as Modular Forms. This is an introductory talk for those who are curious about Modular Forms made famous by the proof of Fermat's Last Theorem.

Speaker: **Andras Domokos**, CSU, Sacremento
Title: Projections onto cones in Banach spaces

Abstract: We generalize the algebraic characterizations of the metric projection onto closed, convex cones in Hilbert spaces, to reflexive, locally uniformly convex Banach spaces with locally uniformly convex dual. The geometrical properties of Banach spaces play a key role. This is a joint work with M.M. Marsh.

Speaker: **Tucker Hartland**, CSU, Chico
Title: Three dimensional spaces of vector valued modular forms.

Abstract: After defining vector valued modular forms for the modular group $\mathrm{PSL}(2,\mathbb{Z})$, we will discuss recent progress in classifying the reducible but indecomposable three dimensional representations of the modular group and the spaces of vector valued modular forms that transform according to said representations. Time permitting we will outline how one can use the data of the representations and spaces of vector valued modular forms to compute the periods of modular curves associated to the kernels of these representations.

Speaker: **Hidefumi Katsuura**, San Jose State University
Title: Some New Results in Elementary Mathematics

Abstract: I will talk a bit of history and some new (I think) results in elementary mathematics. This talk is accessible to beginning calculus students.

Speaker: **Wayne Lewis**, Texas Tech University.
Title: Mapping Properties of the Pseudo-Arc

Abstract: We discuss some mapping properties of the pseudo-arc. Some of these are well known, some are not so well known and some remain to be determined.

Speaker: **Sergio Macias**, UNAM, Mexico.
Title: On continuously type A' θ-continua

Abstract: A continuum X is a θ-continuum (θ_n-continuum, for some positive integer n) if for each subcontinuum K of X, we have that $X \setminus K$ only has a finite number of components ($X \setminus K$ has at most n components). Following Professor E. J. Vought we say that a θ-continuum (θ_n-continuum) is of *type A* provided that it admits a monotone upper semicontinuous decomposition $\mathbf{D}$ whose quotient space is a finite graph, and it is of *type* A' if, in addition, the elements of the decomposition have empty interior. A θ-continuum (θ_n-continuum) of type A' for which the decomposition $\mathbf{D}$ is continuous is a *continuously type* A' *θ-continuum* (*θ_n-continuum*). We characterize continuously type A' θ-continua as those θ-continua of type A for which the set function $\mathbf{T}$ is continuous. We prove that each continuously type A' θ-continuum is a θ_n-continuum for some positive integer n. We show that the n-fold symmetric product of a continuously type A' θ-continuum, for which the elements of the decomposition are nondegenerate, is a Z-set in both the hyperspace of closed subsets of the continuum and the n-fold hyperspace of that continuum.

Speaker: **Marcus Marsh**, CSU, Sacramento
Title: Arc-folders and the fixed point property

Abstract: A *continuum* is a compact, connected metric space. Note that a point is a continuum. Let $\mathcal{G}$ be a class of continua, and let X be a continuum where X admits a montone mapping η onto $[0,1]$ with fibers $\eta^{-1}(t) \in \mathcal{G}$. We call X a *$\mathcal{G}$-folder*. We investigate $\mathcal{G}$-folders, with particular interest in arc-folders and a 35 year-old question of Rudy Gordh, "Do all arc-folders have the fixed point property?"

Speaker: **Kathy Porter**, Saint Mary's College
Title: TBA

Speaker: **Janusz Prajs**, CSU, Sacramento
Title: Uniformly path connected homogeneous continua

Abstract: It is shown that all path connected homogeneous continua are uniformly path connected.

Speaker: **Jesse Prince-Lubawy**, University of North Alabama
Title: Equivalence of cyclic p-squared actions on handlebodies.

Abstract: We consider all orientation-preserving $\mathbb{Z}_{p^2}$-actions on 3-dimensional handlebodies V_g of genus $g > 0$ for p an odd prime. To do so, we examine particular graphs of groups $(\Gamma(\mathrm{v}), \mathbf{G}(\mathbf{v}))$ in canonical form for some 5-tuple $\mathrm{v} = (r, s, t, m, n)$ with $r + s + t + m > 0$. These graphs of groups correspond to the handlebody orbifolds $V(\Gamma(\mathrm{v}), \mathbf{G}(\mathbf{v}))$ that are homeomorphic to the quotient spaces $V_g/\mathbb{Z}_{p^2}$ of genus less than or equal to g. This algebraic characterization is used to enumerate the total number of $\mathbb{Z}_{p^2}$-actions on such handlebodies, up to equivalence.