Rufus Bowen Notebook
https://bowen.pims.math.ca/

Rufus's Legacy

- 40 papers and 2 books in dynamics over only 10 years
- 2800 citations in MathSciNet; most are very recent.
- Bowen-Franks group, Bowen-Margulis measure, Bowen-Series maps, Sinai-Ruelle-Bowen (SRB) measure, Bowen's formula

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Fundamental contributions

- Markov partitions and symbolic dynamics
- Topological entropy
- Entropy, periodic orbits, and equidistribution
- Thermodynamic Formalism (pressure, equilibruium states and Gibbs states)
- Interplay between ergodic theory and smooth structure
- Hyperbolic systems and topology
- Pressure and dimension

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Rufus's Mathematical Descendants

4 PhD students and 24 PhD grand-students

Name	Year of PhD	University
Franco-Sanchez, Ernesto	1974	University of California, Berkeley
Marcus, Brian	1975	University of California, Berkeley
Wong, Sherman	1977	University of California, Berkeley
Young, Lai-Sang	1978	University of California, Berkeley
Kitchens, Bruce	1981	University of North Carolina at Chapel Hill
Branton, Michael	1982	University of North Carolina at Chapel Hill
Trow, Paul	1985	University of North Carolina at Chapel Hill
Ashley, Jonathan	1987	University of California, Santa Cruz
Fahlberg-Stojanovska, Linda	1989	University of Arizona
Hu, Huyi	1993	University of Arizona
Liu, Zheng	1993	University of Arizona
Cleveland, Christopher	1999	University of California, Los Angeles

Name	Year of PhD	University
Cowieson, William	1999	University of California, Los Angeles
Chaichanavong, Panu	2003	Stanford University
Demers, Mark	2003	New York University
Poo, Tze-Lei	2005	Stanford University
Kobre, Elisha	2005	New York University
Wright, Paul	2007	New York University
Koiller, José	2008	New York University
Mintchev, Stanislav	2008	New York University
Yarmola, Tatiana	2008	New York University
Louidor, Erez	2010	University of British Columbia
Ryals, Brian	2013	New York University
Chandgotia, Nishant	2015	University of British Columbia
Garcia-Ramos, Felipe	2015	University of British Columbia
Briceño, Raimundo	2016	University of British Columbia
Blumenthal, Alex	2016	New York University
Chariker, Christopher	2016	New York University

The Notebook

- Historical record
- Window into Rufus's thinking – he anticipated many developments in the past 40 years.
- Short problem statements.
- Much progress made on many problems.
- Bibliographies in PIMS/Fields/NSF proposal and Rufus's Notebook are almost disjoint.

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Pre-history of the Notebook

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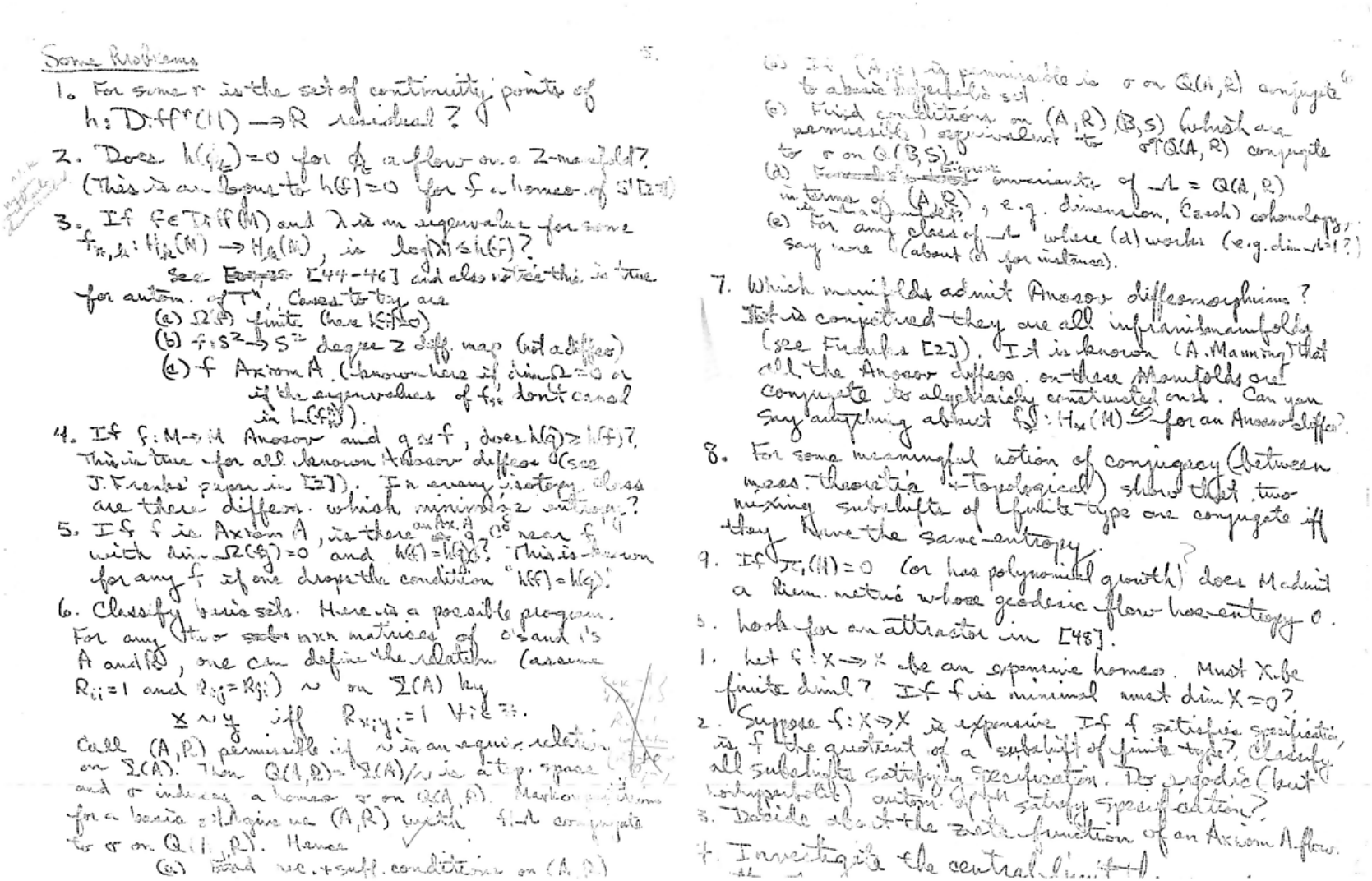

Some Problems

1. For some r is the set of continuity points of $h: \mathrm{Diff}^r(M) \to \mathbb{R}$ residual?
2. Does $h(\phi_t) = 0$ for ϕ_t a flow on a 2-manifold? (This is equivalent to $h(f) = 0$ for f a homeo. of S^1 [2])
3. If $f \in \mathrm{Diff}(M)$ and λ is an eigenvalue for some $f_{*,k}: H_k(M) \to H_k(M)$, is $\deg(\lambda) \le h(f)$? See [44-46] and also is this true for autom. of T^n. Cases to try are
   (a) $\Omega(f)$ finite (here $h(f) = 0$)
   (b) $f: S^2 \to S^2$ degree 2 diff. map (not a diffeo)
   (c) f Axiom A. (known here if $\dim \Omega = 0$ or if the eigenvalues of f_{*k} don't cancel in $\Lambda(f_{*k})$).
4. If $f: M \to M$ Anosov and $g \simeq f$, does $h(g) \ge h(f)$? This is true for all known Anosov diffeos (see J. Franks' paper in [2]). For every isotopy class are there diffeos. which minimize entropy?
5. If f is Axiom A, is there an Ax. A diffeo g near f with $\dim \Omega(g) = 0$ and $h(f) = h(g)$? This is known for any f if one drops the condition "$h(f) = h(g)$".
6. Classify basic sets. Here is a possible program. For any two square matrices A and B of 0's and 1's, one can define the relation (assume $R_{ii} = 1$ and $R_{ij} = R_{ji}$) $\sim$ on $\Sigma(A)$ by
   $$x \sim y \text{ iff } R_{x_i y_i} = 1 \ \forall i \in \mathbb{Z}.$$
   Call (A, R) permissible if $\sim$ is an equiv. relation on $\Sigma(A)$. Then $Q(A, R) = \Sigma(A)/\sim$ is a t.p. space and σ induces a homeo σ on $Q(A, R)$. Markov theorem for a basic set implies (A, R) with A irr. conjugate to σ on $Q(A, R)$. Hence
   (a) find nec. + suff. conditions on (A, R)
   (b) For (A, R) permissible is σ on $Q(A, R)$ conjugate to a basic set?
   (c) Find conditions on (A, R) (B, S) which are permissible, equivalent to σ on $Q(B, S)$ conjugate to σ on $Q(A, R)$
   (d) Find topological invariants of $\Lambda = Q(A, R)$ in terms of (A, R), e.g. dimension, (Čech) cohomology, π_1, ...?
   (e) For any class of Λ where (d) works (e.g. $\dim \Lambda = 1$?) say more (about $\mathbb{Z}$ for instance).
7. Which manifolds admit Anosov diffeomorphisms? It is conjectured they are all infranilmanifolds (see Fiedler [2]). It is known (A. Manning) that all the Anosov diffeos. on these Manifolds are conjugate to algebraically constructed ones. Can you say anything about $f_{*1}: H_1(M) \to H_1(M)$ for an Anosov diffeo?
8. For some meaningful notion of conjugacy (between meas.-theoretic + topological) show that two mixing subshifts of finite type are conjugate iff they have the same entropy.
9. If $\pi_1(M) = 0$ (or has polynomial growth) does M admit a Riem. metric whose geodesic flow has entropy 0.
5. Look for an attractor in [48].
1. Let $f: X \to X$ be an expansive homeo. Must X be finite dim'l? If f is minimal must $\dim X = 0$?
2. Suppose $f: X \to X$ is expansive. If f satisfies specification is f the quotient of a subshift of finite type? Classify all subshifts satisfying specification. Do ergodic (but not hyperbolic) automorphisms satisfy specification?
3. Decide about the zeta function of an Axiom A flow.
4. Investigate the central limit ...

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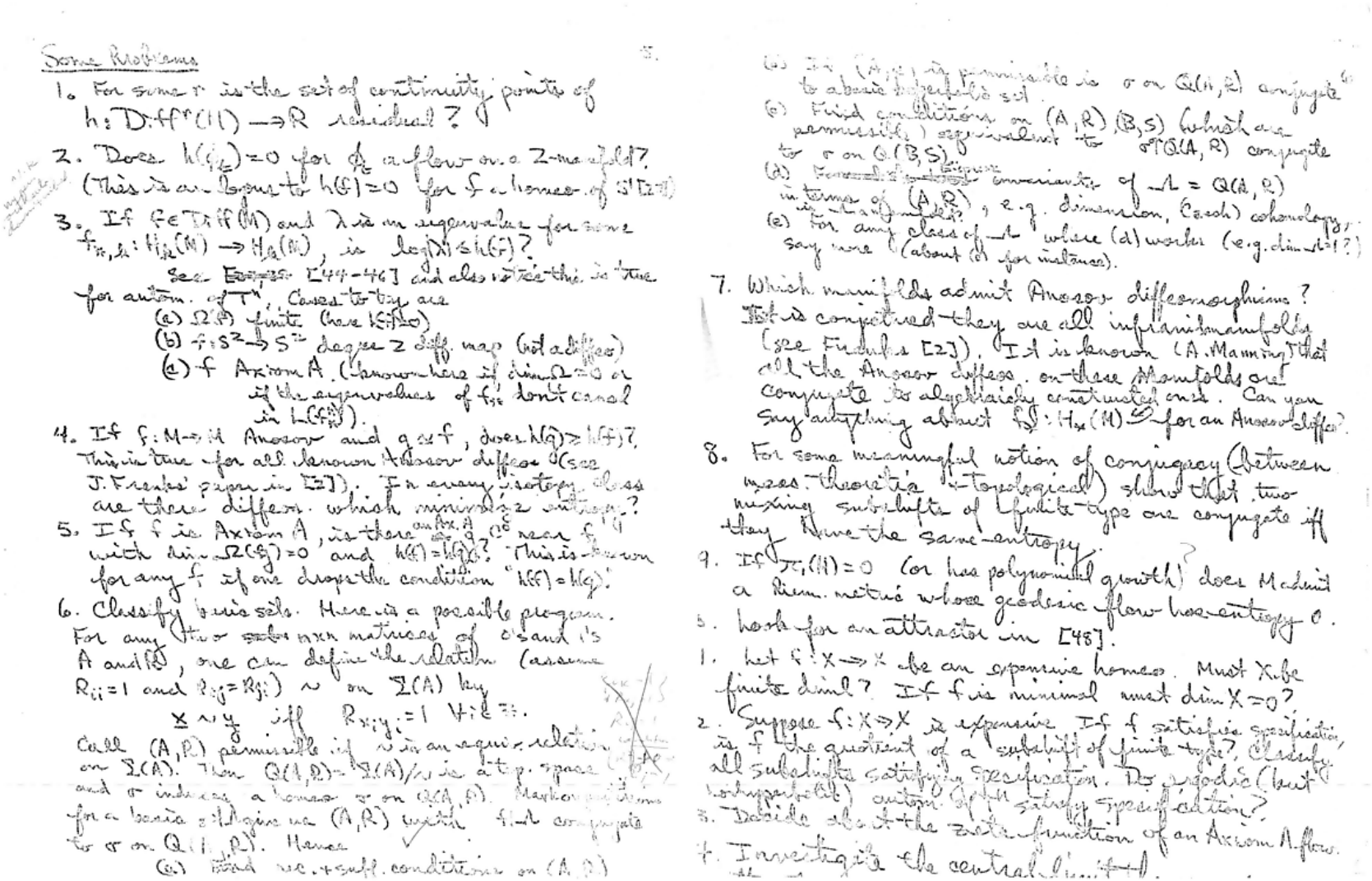

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- Moderated, informal, organic discussions of groups of Notebook problems or problems broadly related to Rufus's work
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- Hyperbolic Dynamics (Y. Coudenes, S, Crovisier, T. Fisher) including “beyond hyperbolicity”, smooth dynamics, interplay between smooth and ergodic
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How to move forward?

- Clarify meaning of and progress on Notebook problems by continuing to input online comments
- Better understand how Notebook problems and Rufus's work fit into today's dynamics landscape, e.g., by writing essays
- Other Ideas ?

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