Handout 2 (Writing): Actions and Characters

Definitions

Subject / Simple Subject The smallest unit of the phrase that the verb is saying something about. It must agree with the verb in number.

- In active sentences with action verbs it corresponds to the actor or cause of the action.
  Examples: The boys are back in town. LeBron James is tall. The baby ate a slug. Debbie broke the violin.
- In passive sentences it is usually the entity that is being affected by the verb.
  Examples: A slug was eaten. The violin was broken by Debbie.

Whole Subject The simple subject, along with any words that modify it. To identify the whole subject, put a *who* or a *what* in front of the verb and turn the sentence into a question.

Examples: The ability of the city to manage education is an accepted fact. (Question: "*What* is an accepted fact?" Answer: "The ability of the city to manage education." The simple subject is *ability*.)

Our dinner guests seemed to enjoy their meal. (Question: "*Who* seemed to enjoy their meals? Answer: "Our dinner guests." The simple subject is *guests*.)

Exercises

These exercises come from Lesson 3 in Williams & Bizup.

Exercise 1

Underline the simple subjects, bracket the verbs, circle the main characters, box the important actions. What do you notice about where these words appear in the sentences?

1a) Once upon a time, as a walk through the woods was taking place on the part of Little Red Riding Hood, the Wolf's jump out from behind a tree occurred, causing her fright.

1b) Once upon a time, Little Red Riding Hood was walking through the woods, when the Wolf jumped out from behind a tree and frightened her.

2a) The Federalists' argument in regard to the destabilization of government by popular democracy was based on their belief in the tendency of factions to further their self-interest at the expense of the common good.

2b) The Federalists argued that popular democracy destabilized government, because they believed that factions tended to further their self-interest at the expense of the common good.

3a) There is opposition among many voters to nuclear power plants based on a belief in their threat to human health.

3b) Many voters oppose nuclear power plants because they believe that such plants theaten human health.

4a) Growth in the market for electronic books is driven by the frequent preference among customers for their convenience and portability.

4b) The market for electronic books has grown because customers frequently prefer their convenience and portability.

5a) The design of the new roller coaster was more of a strugggle for the engineers than had been their expectation.

5b) The engineers struggled more than they expected when designing the new roller coaster.

Exercise 2

One sentence in each of these pairs is clear, expressing characters as subjects and actions as verbs; the other is less clear, with actions in nominalizations and characters often not in subjects.

- First, decide which is which.
- Then underline subjects, bracket verbs, circle characters, and box actions.
- Finally, rewrite the unclear sentence into one in which the actions are verbs, using its paired version as a model.

1a) Some people argue that atmospheric carbon dioxide does not elevate global temperature.

1b) There has been speculation by educators about the role of the familiy in improving educational achievement.

2a) The store's price increases led to frustration among its customers.

2b) When we write concisely, reader understand easily.

3a) Complaints by editorial writers about voter apathy rarely offer suggestions about dispelling it.

3b) Although critics claim that children who watch a lot of television tend to become less able readers, no one has demonstrated that to be true.

4a) The loss of market share to Japan by domestic automakers resulted in the disappearance of hundreds of thousands of jobs.

4b) When educators embrace new-media technology, our schools will teach complex subjects more effectively.

Exercise 3

Rewrite these sentences so the nominalizations are verbs and characters are their subjects.

1) Lincoln's hope was for the preservation of the Union without war, but the South's attack on Fort Sumter made war an inevitability.

2) Attempts were made on the part of the president's aides to assert his immunity from a congressional subpoena.

3) Your analysis of my report omits any data in support of your criticism of my findings.

4) The agreement by the class on the reading list was based on the assumption that there would be tests on only certain selections.

5) There was no independent business-sector study of the cause of the sudden increase in trade surplus.

6) Your analysis of my report omits any data in support of your criticism of my findings.

Exercise 4

On the following pages are a few abstracts, selected from talks at various familiar math departments. Choose *one* abstract (or find another one if you prefer), and do the following:

- Identify subjects, verbs, characters, actions
  - Ask: Are there actions hidden in nominalizations?
- Rewrite each sentence (or a selection of at least ~3-4 sentences, if the abstract is long), so that
  - Actions are verbs, and characters are subjects
  - There are as few nominalizations as possible.

As you rewrite, don't worry about whether the abstract improves as a whole – this is an exercise in writing sentences in different ways, not in writing good abstracts. But, do take a mental note of what improves, and what may feel awkward.

Please submit your revised abstract by email to Miranda (holmes at cims), or type it directly into the slides if the link is available (remember to include your name.) Indicate which abstract you are revising, and include the original abstract if you choose your own.

1) Dynamics, Mixing, and Coherence

Coherent regions in geophysical flows play fundamental roles by organising fluid flow and obstructing transport. For example, in the ocean, coherence impacts dynamics from global scales down to scales of at least tens of kilometres, and strongly influences the transportation of heat, salt, nutrients, phytoplankton, pollution, and garbage. I will describe some recent mathematical constructions, ranging across dynamical systems, probability, and geometry, which enable the accurate identification and tracking of such structures, and the quantification of associated mixing and transport properties. I will also present case studies from a variety of geophysical settings.

2) Micro-swimmers moving in complex confinement

Interactions between micro-swimmers and solid boundaries play an important role in many biological and technological processes. I will discuss recent advances in experiments and simulations that aim to understand the motion of micro-swimmers such as bacteria, micro-algae, spermatozoa or active colloids in various confinements or structured environments. Our results highlight
the complex interplay of the fluidic and contact interactions of the individuals with each other and the boundaries to give rise to complex individual and collective behavior.

3) DeepLabCut: A Deep Learning Tool for Fast, Robust, and Efficient 3D Pose Estimation

Quantifying behavior is crucial for many applications across the life sciences and engineering. Videography provides easy methods for the observation and recording of animal behavior in diverse settings, yet extracting particular aspects of a behavior for further analysis can be highly time consuming and computationally challenging. I will present an efficient method for markerless pose estimation based on transfer learning with deep neural networks that achieves excellent results with minimal training data. I will demonstrate the versatility of this framework by tracking various body parts in multiple species across a broad collection of behaviors from egg-laying fruits flies to hunting cheetahs. Moreover, I will show that for both pretrained and networks trained from random initializations, better ImageNet-performing architectures perform better for pose estimation, with a substantial improvement on out-of-domain data when pretrained on ImageNet.

4) Implicit, manifold-preserving numerical representations and solvers for multiscale kinetic simulations of plasmas

First-principles models for plasma simulation (such as the Vlasov-Maxwell and Vlasov-Fokker-Planck models) are high-dimensional (6D+time), highly nonlinear, and exceedingly multiscale. However, their efficient and accurate solution is key for progress in many areas of applied plasma physics, including magnetic confinement and inertial confinement fusion. While effective solution methods have been developed in both collisional and collisionless regimes for specific applications, we argue by example that manifold-preserving numerical methods are key for asymptotic well-posedness in general. Such methods strictly respect continuum constraints such as positivity and conservation invariants, and must be implicit in time and adaptive to be able to bridge disparate temporal and spatial scales without drifting from physical solutions. This, in turn, demands effective nonlinear solver strategies. Here, we leverage low-dimensional (e.g., fluid moment) models and efficient, scalable multilevel inversion methods to produce very competitive iterative solution methods. In this talk, we will introduce recent breakthroughs in manifold-preserving implicit numerical representations and associated low-dimensional solvers for both collisionless Lagrangian and collisional Eulerian kinetic plasma models, and will demonstrate their effectiveness with various applications of interest.

5) Real-time Decision Making in Networked Dynamical Systems: Algorithms, Fundamental Limits, and Applications

Recent radical evolution in distributed sensing, computation, communication, and actuation has fostered the emergence of cyber-physical networked systems, across a broad spectrum of engineering and societal fields. Many challenges arise in shaping the network collective behavior through coordinating individual components, such as the large scale of the network, limited communication, inherent uncertainties, and complex intertwined physics and human interactions. In this talk, I will present our recent progress in formally advancing the systematic design of real-time decision making in networked systems, focusing on the challenges raised by uncertainties from two aspects. One is caused by unknown system dynamics and the other is caused by a volatile external environment. We firstly present our recently developed scalable multiagent reinforcement learning algorithms which only use local sensing and communication yet learn nearly-optimal localized policies for the global network. Then we present our online optimal control algorithms with time-varying convex cost functions and rigorously show how to use prediction effectively to reach a nearly-optimal online performance with fast computation. In the end, I will briefly present our other work as well as some real-world system tests and implementations.

6) Computation of regularity, stability and passivity distances for dynamical systems with port-Hamiltonian structure

Port-Hamiltonian systems are an important class of control systems that arise in all areas of science and engineering. When the system is linearized around a stationary solution one gets a linear port-Hamiltonian system. Despite the fact that the system looks unstructured at first sight, it has remarkable properties. Stability and passivity are automatic, spectral structures for purely imaginary eigenvalues, eigenvalues at infinity, and even singular blocks in the Kronecker canonical form are very restricted and furthermore the structure leads to fast and efficient iterative solution methods for associated linear systems. When port-Hamiltonian systems are subject to (structured) perturbations, then it is important to determine the minimal allowed perturbations so that these properties are not preserved. The computation of these structured distances to instability, non-passivity, or non-regularity, is typically a very hard optimization problem. However, in the context of port-Hamiltonian systems, the computation becomes much easier and can even be implemented efficiently for large scale problems in combination with model reduction techniques. We will discuss these distances and the computational methods and illustrate the results via an industrial problem in the context of noise reduction for disk brakes.

7) A Conditional Gaussian Framework for Uncertainty Quantification, Data Assimilation and Prediction of Complex Turbulent Dynamical Systems

A conditional Gaussian framework for uncertainty quantification, data assimilation and prediction of nonlinear turbulent dynamical systems will be introduced in this talk. Despite the conditional Gaussianity, the dynamics remain highly nonlinear and are able to capture strongly non-Gaussian features such as intermittency and extreme events. The conditional Gaussian structure allows efficient and analytically solvable conditional statistics that facilitates the real-time data assimilation and prediction. This talk will include three applications of such conditional Gaussian framework. In the first part, a physics-constrained nonlinear stochastic model is developed, and is applied to predicting the Madden-Julian oscillation indices with strongly non-Gaussian intermittent features. The second part regards the state estimation and data assimilation of multiscale and turbulent ocean flows using noisy Lagrangian tracers. Rigorous analysis shows that an exponential increase in the number of tracers is required for reducing the uncertainty by a fixed amount. This indicates a practical information barrier. In the last part of the talk, an efficient statistically accurate algorithm is developed that is able to solve a rich class of high dimensional Fokker-Planck equation with strong non-Gaussian features and beat the curse of dimensions.

8) Kahler-Einstein metrics

Kahler-Einstein metrics are of fundamental importance in Kahler geometry, with connections to algebraic geometry, geometric analysis, string theory amongst other fields. Their study has received a great deal of attention recently, culminating in the solution of the Yau-Tian-Donaldson conjecture, characterizing which complex manifolds admit Kahler-Einstein metrics. I will give an overview of this conjecture, and describe some more recent developments.